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China Report

SCIENCE AND TECHNOLOGY

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CHINA REPORT

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NATIONAL DEVELOPMENTS

EFFECTS OF S&T REFORM ON CONDITIONS IN CHINA EXPLORED

Hong Kong LIAOWANG [OUTLOOK] in Chinese No 24 16 June 86 pp 15-16

[Article by Zhou Daping [0719 1129 1627]: "Reform of the Chinese Science and Technology System Has Brought Pleasing Changes"]

[Text] The reform of the Chinese science and technology system has greatly hastened the rapid and broad application of scientific and technical achievements in production, and has opened up an even more vast territory in which scientists and technicians can function positively in economic construction. This reform is playing an ever more obvious role in freeing up production forces and promoting economic and social developments.

Opening Up the Technology Markets

The "Resolution Regarding Restructuring of the Science and Technology System" issued by the Central Committee in March 1985 fully affirms the commercialization of technical commodities and the opening of technology markets that has evolved in recent years. The dissemination of Chinese scientific and technical commodities has always been through allocation by government departments and through uncompensated transfer of rights according to subordinate relations. This kind of administrative method is not conducive to the rapid and broad application of scientific and technical achievements in production. With development of the commercial economy, various technology trade activities have appeared in succession. More and more small and medium enterprises have realized the value of knowledge and the function of talent, and they have not been afraid to spend the money for technology, nor have they been put off by the seeking and employment of talent. Therefore, scientific and technical achievements have gotten away from the restraints of traditional management models, and have entered the realm of commodity circulation to become "hot items" unable to meet demand. In this way, technology markets, that use economic levers to accomplish the transfer of rights to scientific and technical commodities through direct discussions between buyers and sellers, have rapidly developed throughout the country. By the end of 1985, there were more than 5,000 organizations undertaking technology trade.

Science research units have obtained research projects from the technology markets, and have also obtained bases from which to carry out intermediate experiments, which has quickened the industrial development of technologies;

production units have obtained advanced functional technical commodities from the technology markets that have strengthened their capacities for absorption of technology. During the period of the Sixth 5-Year Plan (1981-1985), nearly half of the scientific and technical achievements of the Chinese Academy of Agricultural Science have been used in actual production, which is inseparable from the following point: the 33 affiliated institutes (laboratories) established research and production associations with 10 prefectural and municipal town and township enterprises. There have now been more than 9,800 associations of this type established in China.

The development of the technology markets has greatly improved the rate of application for scientific and technical achievements. Looking at the first technology market in the country, the Wuhan Municipal Technology Market, as an example, the rate of application of scientific and technical achievements in 1981 was only 10 percent, but by 1984 had grown to be more than 60 percent. The total volume of technology transactions in technology markets throughout the country have abruptly increased from the 1.5 million yuan of 1983 to the more than 2.3 billion yuan of 1985.

The constant flow of scientific and technical commodities into the fields of production is certain to stimulate the reasonable movement of personnel and the development of intellect. In the past few years, Hebei Province has attracted scientists and technicians by the thousands from the science and technology talent rich Beijing-Tianjin area to cooperate in developing technologies with provincial enterprises, which has vigorously advanced economic development throughout the province.

It should be said that as science research units serve society more, the economic results obtained therefrom are greater, and the capacity for undertaking redevelopment is therefore stronger. This is also of use in the establishment of mechanisms by which the technology development of research units and colleges and universities can recover their investments. In 1985, net income for more than 40 colleges and universities from technology trade was 80 million yuan, equivalent to 30-40 percent of the science research operating expenses for these institutions. This excellent environment for self development established by science research units is a prerequisite condition for reforming the existing science and technology allocation system.

China's technology markets are new things that will continue to advance and improve in the process of development. In March of this year, the State Science and Technology Commission Chairman, Song Jian, spoke at the National Technology Market Working Conference, where he said, "The goal of the reform is to create an environment that will allow research units and research personnel to have direct contact and relations with society. This is a crucial measure for the reform." At present, the State Science and Technology Commission is enhancing coordination, leadership, and management of technology markets, and has as well begun formulating relevant associated rules and regulations. This will allow the technology markets to better serve as bridges and links in promoting the integration of science and technology with the economy.

The Academy of Sciences Opens Up Some Laboratories

The socialization of science research units is a tendency in the development of science and technology in China. For the Chinese Academy of Sciences to open up laboratories allows them to be shared by scientists throughout the country and to receive the benefits in which objects are made the most of and people realize their talents. This measure itself shows the excellent beginning for this trend.

In the past, because of the closed form of the science research system in which "departments owned all and individuals worked for the government," it was even hard for research personnel to transfer, so the rate of usage for experimental instruments and equipment was low. In August 1985 the Chinese Academy of Sciences faced up to this abuse and in a planned way opened some institutes and laboratories to the rest of the country. On the one hand, this provides scientists and technicians not affiliated with the Chinese Academy of Sciences with the most advanced instruments and equipment. On the other hand, their constant infusion of new academic ideas, thinking, and research directions enlarges the scope of possibilities for cooperation in research. Consequently, this can promote exchanges among the sciences and also has great significance for the development of basic science.

Before the structural analysis laboratory of the Chinese University of Science and Technology was opened to the public, many sophisticated instruments and equipment were only used a few times a year. Since its opening up, they are in operation nearly 24 hours a day all year long. Some developed countries have obtained noteworthy results in research on fungi that are in close contact with human life, while research in this area in China has progressed quite slowly. The fungi laboratory of the Chinese Academy of Sciences' Institute of Microbiology has the only fungi incubator in China, and before the opening up it was difficult to realize its potential, nor was the enthusiasm of scientists and technicians given full rein. But now, after opening up the fungi incubator, our level of scholastic research has improved.

Opening up the laboratories brings a new strength to scientific and technical exchanges and cooperation between the scientific academies and the higher institutions and industries, which has quickened the pace at which scientific and technical achievements are disseminated and applied. The Chinese higher institutions are a science research contingent of nearly 400,000 that is of multiple disciplines and multiple levels. The amount of transactions in the transfer of rights to technology was more 126 million yuan in 1985.

The opening of the laboratories by the Academy of Sciences has been greeted by universal welcome in science circles. Among the 360 projects in the 17 laboratories of the mathematics institute and the institute of theoretical physics that were the first to be opened, 70 percent are projects outside the institute or are in cooperation with the outside; among the more than 1,200 scientists and technicians participating in research on these projects, 60 percent are specialists and scholars outside the institutes. Currently, the Academy of Sciences is setting up and perfecting management methods for science. It is estimated that not long from now there will be even more

institutes and laboratories that will be opened to scientists within this country, and some will be opened to those abroad as well.

The Rise of "Spark Plans" and of the Rural Economy

In recent years, one of the major indications of the tremendous changes in the rural economy has been the rise of town and township enterprises as a new force. At present, town and township enterprises employ a rural labor force of 60 million and have continued to support agriculture in the areas of funding, agricultural technology, and mechanized power. Output value of town and township enterprises has reached 248.1 billion yuan, approaching 20 percent of the national industrial and agricultural gross output value. Premier Zhao Ziyang has pointed out that "it will not be acceptable to transform agricultural structures without developing town and township enterprises, and there will be no future for the transformation of town and township enterprises without relying upon science and technology." The "spark plans" were born under just these conditions and are a grand blueprint for the gradual arming of the rural economy with modern science and technology.

Five years ago, while organizing research by the State Science and Technology Commission into developing the Taihang mountainous area, the "sparks and tinder" that are science and technology were brought there for the first time. Today, the rural economy of the Taihang mountainous region continues to flourish, per capita income having grown more than four times over that of 1981. Lingchuan County, Shanxi, located at the top of the Taihang mountains, depended for a long time upon the finances of the state to supplement its living. Since the introduction of science and technology, things have prospered year after year until the gross output value for the county's town and township enterprises broke through the hundred million yuan mark to create the highest level in the history of that county.

The prosperity of China cannot be separate from the countryside, while the prosperity of the countryside depends upon continued development of town and township enterprises and continued strengthening of rural science and technology contingents. In the understanding of the leading group of the State Science and Technology rural survey, some of the key projects in contemporary agricultural production still await resolution, and the technical production management standards of town and township enterprises need to be improved. The existing 14 million strong scientific and technical contingent in this country, in control of the great majority of scientific and technical information and achievements, has the complete capacity to serve the increased agricultural production and the transformation and improvement of town and township enterprises. During the period of the "Seventh 5-Year Plan," in meeting the requirements of the "spark plans," 100 kinds of complete sets of technologies and equipment will be developed for town and township enterprises throughout the country, at the same time as large-scale production is arranged; entire techniques and technologies, management rules and regulations, product designs, and methods for quality control will be provided for 500 model technology enterprises among them; and more than 1 million people will be trained in a specialist technology. It can be presumed that on behalf of the integration of science and technology with the rural economy, the "spark plans" will create many valuable experiences that are in keeping with the Chinese national situation.

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CSO: 4008/2117

NATIONAL DEVELOPMENTS

EMPHASIS ON MILITARY TO CIVILIAN TRANSFER URGED

Xian SHAANXI RIBAO in Chinese 4 Aug 86 p 2

[Report by Xu Xing [1776 5887]: "Vigorously Adapt to the Shift in Strategy for National Defense Science and Technology Industries"]

[Text] In accordance with scientific decisions regarding international and domestic trends, the central authorities have resolutely adjusted the plans of this country for the building of national defense. Requiring the national defense science and technology industry to make major strategic changes regarding service, the military and industry system, the guiding ideology for work, and management will take the major strength of national defense science and technology from the "little universe" of military-industrial production to the main battlefield of the national economic construction. It will serve the overall building toward modernization, and will allow the national defense science and technology industrial contingent to become the main army and strikeforce for the drive toward modernization. This wise decision by the central authorities has a far-reaching historical significance, as well as great practical significance.

How are we to adapt to this historical change? In my opinion:

We must first proceed from the general situation of national construction and correctly recognize the situation confronting national defense industries. We have reduced production tasking of military goods to a great degree. This was to comply with the general situation regarding economic construction, and was at the same time to better promote the modernization of national defense. We must be certain to realize this point, that from the point of view of guiding ideology, we have turned from a purely defense orientation to one that serves the four drives toward modernization.

Establishing joint military civilian enterprises is a long term strategic principle, definitely not just for expediency, and is the second problem of recognition about which we must be clear. In recent years, the steps some of the military industrial enterprises in this province have taken toward shifting from the military to the civilian have not been great ones. One of the main reasons has been that understanding of this problem has been insufficient, that there have been wait-and-see attitudes and a willingness to leave to chance, and a hope that one day we would again deal with purely

military commodities. Many enterprises are still used to "tasking by the government, materials provided by the government, products sold by the government, profit or loss taken care of by the government," which is certainly not appropriate to the shift toward producing civilian goods. We have now made the decision to make a big and quick shift, which is the current trend and for which there can be no hesitation. Only if military industrial enterprises can be aware of this historical trend and can strive for the autonomy to develop will they be able to develop their potential advantages, and will they have a broader field in which to deploy their arms.

Third, we must improve knowledge of the new joint military civilian systems. What do we mean by joint military civilian types? Leading comrades of the central authorities have pointed out that joint military civilian enterprises are new types of dual nature systems that require military industrial enterprises structurally to take on both military goods and civilian goods gradually. The principle of production for enterprises, rules for construction, and production line facilities should all be managed in accordance with this thinking. Only if this problem is clear can military industrial enterprises be fully free to operate, can they have long term planning, and can they have a new vitality. Some military industrial enterprises have long lacked vitality, an important factor of which is that there has been no true understanding of the far-reaching significance of the joint military industrial format.

The key to realizing this change in strategy regarding national defense science and technology industries is in the change in structure. National defense science and technology industries are very important social production forces, but the current structure still hinders the development of production forces, obstructing the fulfillment of the advantages and potential of national defense science and technology industries. The situation requires that we make use of restructuring and a heightened spirit to bring big changes to the realization of this system. It requires that we change the military industrial structure to a vital structure, and that we allow the truly powerful national defense science and technology industrial contingent to move toward the broader world of our drive toward modernization, to make contributions toward the prosperity of the national economy.

To establish this new structure that is an association of the military and civilian, we must proceed from the two aspects that are the industry as a whole and the enterprises themselves. Within the enterprise, there should be an adjustment of commodity structures, a shift from pure production of military goods to "an integration of the military with the civilian, with a focus on the civilian." We should reasonably arrange for proportional relations between military and civilian goods, should learn how to accomplish the two capabilities that are the military and the civilian, should be able to have both mainstay military commodities and also mainstay civilian commodities, all to constitute a situation of self sufficiency for both military and civilian goods, where they develop in coordination. At the same time, we must solidify establishment of the concept of a commodity economy to truly realize the change from a provisional model to an operational one, and must enhance the sense of urgency for marketplace competition. In the past military industrial enterprises were generally of the closed, provisional

type. They produced few goods over a long term and at high cost, and had little competitive capacity. Only if military industrial enterprises can quickly implement open, operational modes can they completely realize their own technical and equipment advantages. Only then will they enhance their competitive capacities and stand on firm ground. In addition, under the prerequisite of finishing their tasking for military goods, they will establish a rather complete civilian goods production and science research system, which can fundamentally achieve independent development of various new kinds of civilian goods, earnestly accomplishing a secondary development of military goods and a shift toward civilian use industries and civilian use commodities.

Another important aspect to the system restructuring is a streamlining of government and a release of authority to the enterprises. The planned and gradual release of authority from the military and industrial enterprises to the local level is a major strategic measure by which to implement the shift from military industrial enterprises to joint military and civilian models. Only by freeing them up with equal conditions for competition can enterprises be invigorated, and can the preservation of the military while shifting to the civilian have an exuberant vitality.

Shaanxi Province is one of the provinces in which national defense science and technology enterprises are rather concentrated. Since the 3d Plenary of the 11th CPC Central Committee, the development of military industrial enterprises into production of civilian goods has had a certain success. But overall, that development has not been an ideal one, and the steps toward changing to joint military civilian models have not been great, still quite far from the demands of the party Central Committee.

The strategic shift toward implementation of a joint military civilian system will be effected in many areas of effort, and will be realized in practical actions. To this end, we must pay special attention to the following tasks:

1. Enterprises must greatly enhance new product development and technology development in accordance with economic development strategies in order to hasten the pace of shifting from the military to the civilian. At the same time as we control the development of military goods, development of civilian goods must pay close attention to the major commodities arranged for by the state and the province. Each enterprise should integrate its own characteristics to take on one or more "mainstay commodities."

2. Focusing on the development of civilian goods, we should earnestly deal with the technology transformation of the military civilian joint models. In the development of civilian goods, we must select those commodities accurately and keep to higher starting points, paying special attention to economic batch quantities. For those civilian goods that do not currently constitute economic batch quantities, attention should be paid to association, matching, transformation, and management to more quickly attain batch quantities. Development of civilian goods and technology transformation must make full use of production conditions currently existing in military industrial enterprises, must make full use of advantages, exploit potential, and constitute new production capacities.

3. For well known goods newly on sale, and especially for products that can be exported and earn foreign exchange and that can replace imported goods, arrange for military industrial enterprises and for civilian enterprises to undertake joint development, joint testing, and joint manufacturing, to gradually form a new type of economically integrated organization, and to develop a group of enterprise associations or enterprise groups.

4. Vigorously develop technical services and technical business activities to hasten the shift from military industrial technology to the civilian. In accordance with the "spark plans" as formulated by the state, pay close attention to developing a group of "short, even, and quick" projects to provide new practical technology for regional small to medium enterprises and to promote technical advances.

5. Pay very close attention to the link of circulation, strengthen marketing, "use marketing to stimulate production, production to create marketing," and establish a concept of a socialist planned commodity economy. This is an important link for the development of civilian goods production. Military industrial enterprises must take care of this link through the integration of military with civilian to allow commodities to be "known by the people, used by the people, and enjoyed by the people."

6. Consider the entrance of civilian goods into the international marketplace as a key direction for developing the advantages of military civilian enterprises, which will gradually constitute a base by which some individual products can be exported and earn foreign currency.

7. Pay close attention to the restructuring of systems internal to medium and large enterprises, create small units for accounting, clarify the economic responsibility systems, and make full use of subjective mobility to allow them to operate independently and be responsible for their own profits and losses, and to strengthen the economic and operational vitality of the factories.

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NATIONAL DEVELOPMENTS

MILITARY SCIENCE ACADEMY OPENS RESEARCH TO DOMESTIC UNITS

Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 22 Aug 86 p 4

[Report by Bao Shixiu [7637 0013 0208] and Liu Guanxian [0491 7070 6343]: "Our Military Science Academy Has Begun Open Research"]

[Text] The PLA Military Science Academy Director Zheng Wenhan [6774 2429 5060] and Political Commissar Wang Chenghan [3769 6134 3352] recently let it be known that hereafter the Military Science Academy would not only be open to the outside, establishing relations with domestic research units, but also would enthusiastically create conditions by which to establish relations with foreign military units and relevant scholastic organizations and scholars.

The Chinese PLA Military Science Academy was founded in March 1958, and the first director and concurrent political commissar was Marshal Ye Jianying. The Military Science Academy has primarily been engaged in research in the areas of military theory, military ideology, strategy, campaigns, tactics, military systems, military history, foreign military studies, and troop political work, making use of automated equipment for battle operations research and analysis, being responsible for the writing and revision of relevant regulations and ordinances, and for editing the "Chinese Military Encyclopedia" and other reference books. This academy has paid special attention to national defense strategies of development and practical research into relevant troop establishment and problems of warfare. It has provided the Military Commission of the Central Committee and the PLA General Political Department with suggestions and advice regarding decision making.

For some time now, the Military Science Academy has adopted a closed mode for research. As far as the majority of people outside the military and both in and out of this country have been concerned, the Military Science Academy has been unknown. These two officials feel that doing research in this modern situation requires enhancement of lateral relations and the opening up of research. The development of military science must be oriented to what is modern, to the world, and to the future. In adopting a closed form of research, we cannot generate advanced military thinking, and it is insufficient for responding to the challenge of future conflicts to traditional battle theories. Over the past few years, the Military Science Academy has done some work in the area of establishing relations with the outside. The first thing has been to stress scholastic exchanges. This year,

they have held the "Academic Conference on National Defense Strategy and Systems Engineering in the Year 2000," and will join with related units to hold academic conferences on Chinese modern military history, to commemorate the 50th anniversary of the Long March victory by the Red Army, and on troop management. Then, it will invite specialists and scholars from within and outside the military to evaluate military and scholastic end products. Third, it will strengthen lateral relations. This year, it has already discussed jointly with various related academic and research sectors planning and coordinating work for military scholastic research throughout the military. It has also sent out survey groups to all army strength areas and relevant institutions to understand the situation regarding academic research.

They were also happy to discuss the open-door policy of economic construction in this country, which created advantageous conditions for opening up military science studies. We want to make full use of the current excellent conditions and excellent opportunities to gradually establish connections with foreign military research organizations and their specialists and scholars, whereby to undertake far-reaching scholastic exchanges. The Military Science Academy has the ability to participate in various relevant scholastic activities internationally.

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NATIONAL DEVELOPMENTS

CAS SCIENTISTS TO PARTICIPATE IN POLICY MAKING

HK150242 Beijing CHINA DAILY in English 15 Sep 86 p 3

[Article by staff reporter]

[Text] The Chinese Academy of Sciences [CAS] will be more active in organizing China's top scientists to contribute to the democratic and scientific policy-making sought by the Chinese leadership, said Yan Dongsheng, vice president of the academy, at a meeting of the Technical Science Academic Division that opened yesterday.

He said that as the members of the academy are the most outstanding scientists and experts in China, they should participate in state policy-making as special counsellors.

So, for the first time, over 90 well-known academics from different fields, 40 government officials and 20 technical experts from local enterprises gathered together to compare notes on the current social, economic and scientific developments.

"We've invited officials from major government departments to report and join discussions at the meeting. We believe this will help our scientists know more about the level and needs of national development," Yan said.

According to Shi Changxu, director of the technical science division, the academy will propose four main subjects for its members to deliberate on and provide advice for the government.

The subjects include the allocation and utilization of resources; development of infrastructure; high-tech research, urban and rural construction and environmental protection.

CAS expects the scientists will form special subject groups and raise their research projects during the four days of reports and discussions. After the meeting, the groups will set out on study and field inspections.

"We hope the scientists will bring out some valuable reports in a couple of years. Because we are at an experimental stage so far, we'll focus on a few subjects at present. In future, we'll expand the counselling into more fields," Yan said.

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CSO: 4010/2002

NATIONAL DEVELOPMENTS

TELEVISION TO BE POPULARIZED IN RURAL AREAS

OW240726 Beijing XINHUA in English 0727 GMT 24 Aug 86

[Text] Harbin, 24 Aug (XINHUA)--The electronics Industry Ministry calls for rural China to popularize television in the near future, said an official at a meeting on television popularization here today.

Five measures, adopted at the meeting, are as follows:

--Put the market emphasis on cheaper black-and-white television sets;

--supply complete sets of television equipment including satellite television receivers, relay receiver- transmitters and public aerials;

--encourage group sales;

--enhance maintenance service; and

--lower the selling price.

Increased domestic television production and improved living standards create a favorable condition for television popularization in the countryside. However, shortage of famous-brand tv sets and poor maintenance service hinder sales.

China has an annual production of 16 million tv sets. Demand for black-and-white tv sets has been diminished among urban residents who are turning to color models. The rural areas, where, on average, each 100 households possess 11.8 tv sets, have a large potential market, said the official.

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CSO: 4010/1002

NATIONAL DEVELOPMENTS

TECHNOLOGY TRANSFER BY MINISTRY OF AEROSPACE INDUSTRY

Beijing BEIJING KEJIBAO in Chinese 18 Jul 86 p 2

[Article by Jin Yan [6855 1484]; first paragraph is source supplied introduction]

[Text] Editor's note: The No 31 Institute of the Ministry of Aerospace Industry has established a policy of technology transfer for the benefit of the general public rather than just to enhance their own profits. They have implemented a plan where technologies are transferred to the receiving organizations based on geographic regions, orders received, and priorities. By temporarily sacrificing their own interests, the state will benefit in the long run because most receiving organizations can enjoy healthy growth. If more organizations will follow the example of the No 31 Institute, the resulting social and economic benefits can be substantial.

The No 31 Research Institute of the Ministry of Aerospace Industry has received favorable comments from technology-receiving organizations for their far-sighted policy of not seeking only near-term profits and for their innovative approaches in technology transfer.

In 1984, this Institute developed the new technology,"producing asphalt using cotton-seed nigre", which was quickly transferred and produced visible economic benefits. However, because of their failure to consider the distribution of customer demand, the price of raw material rose sharply, and many new businesses were forced to close down. Last July, the Institute developed another new technology--producing pure alkali, which could be readily adopted by medium and small enterprises. But after receiving orders from several hundred customers around the country, they decided to carefully review the overall interests of their customers in addition to their own economic benefits, and implemented the following measures.

Based on the data provided by the raw materials survey bureau, they concentrated the development in regions with ample supply of raw materials while at the same time taking into consideration the rationality of the distribution process. For customers located in a region where raw materials are rare, they would suggest that this technology not be accepted. For regions where the availability of raw materials is uncertain, the decision of technology transfer would be postponed until a detailed survey has been conducted.
The Institute has developed a number of additional production technologies which are currently being transferred. Again they insist on the policy of "customers first", so that small enterprises in towns and villages can healthy growth.

NATIONAL DEVELOPMENTS

PLANS SOLIDIFYING FOR S&T ALLOCATION REFORM

Beijing RENMIN RIBAO in Chinese 15 Aug 86 p 2

[Report by Zhuo Pei [0587 1014 2837]: "Full Scale Reform of Science Research Operating Expenses Is Readied"]

[Text] Concerned areas have been notified that work by all departments of the State Council on restructuring of science research operating expenses is now ready. As of now, indexes for science research operating expenses from 53 departments have been transferred from the Ministry of Finance to management by the State Science and Technology Commission. Categorization by research organizations affiliated with the departments has been basically completed, and the 1986 budget for science research expenses at the Central Committee level has been promulgated in accordance with the new management channels. This reform has also begun to a certain degree within all provinces, municipalities, and autonomous regions.

The reform in research operating expenses is a component part of the entire restructuring of the science and technology allocation system. In January of this year, based on the spirit of the resolution by the Central Committee regarding restructuring of the science and technology system, the State Council has published the provisional regulations for the management of science and technology allocations. It has been determined that there will be categorical management of research organizations in accordance with differing activities and characteristics, whereby expense management methods such as the contract system, the fund system, and the responsibility system are each adopted. It has been decided at the same time that beginning this year the science research operating expenses that had formerly been allocated to research organizations through responsible departments according to number of personnel would be redesignated to be under the uniform management of the State Science and Technology Commission.

On the basis of experiences obtained through restructuring of the science research operating expenses of all departments of the State Council, the Office of Culture and Education of the Ministry of Finance and the Bureau of Regulations of the State Science and Technology Commission have recently held a conference on the restructuring of national and local science research operating expenses, where it was decided to hasten the progress of this restructuring in the provinces, municipalities, and autonomous regions.

Science and technology contingents from the provinces, municipalities, and autonomous regions occupy an important position among the structures of science and technology strength in this country, among which scientists and technicians account for more than one-half and operating expenses are nearly one-third of allocations for national science research operating expenses. At the same time, this contingent is also a most vital force in catering to the economy. Among the 1,500 science research organizations that have instituted contract systems and the 317 science research organizations that have become economically independent, those at the provincial, municipal, or autonomous region level occupy 87.7 percent. Therefore, it is recognized in relevant areas that to hasten the progress of restructuring science research operating expenses for provinces, municipalities, and autonomous regions, full scale initiation of the restructuring of science research operating expense allocation, and even the development of the situation regarding restructuring of the entire science and technology system, will be a powerful incentive.

Zeng Xianlin [2582 2009 2651], deputy director of the State Science and Technology Commission and deputy director of the State Economics Commission, spoke at the conference, requesting that each region come up with a plan for restructuring as soon as possible, that they formulate working plans, and that by the second half of the year they finish solidifying this work, so that there will be a good foundation for full scale categorical management next year. At the conference, some provincial, municipal, and autonomous region comrades explained their situations regarding relevant restructuring preparations.

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NATIONAL DEVELOPMENTS

MUCH OF CHINESE S&T CALLED 'STATE OF THE ART'

Hong Kong WEN WEI PO in Chinese 12 Aug 86 p 3

[Article by Jie Ling [0267 7227]]

[Text] The Minister of China's Nuclear Industry, Jiang Xinxiong, admitted that the published report on the safety problem of the Daya Bay nuclear power plant only addresses general issues, and does not contain sufficient details. For this reason, this Ministry is in the process of preparing a more comprehensive report which will discuss the safety problem in greater detail. This report will be made public as soon as it is completed.

This message was passed on by the Secretary of Public Affairs of the Hong Kong Scholars Association, Xu Shixiong (professor of biology at the Hong Kong University), during a news conference where he gave a report on the results of his recent visit to mainland China. According to Prof. Xu, Minister Jiang Xinxiong believes there will be little flexibility in changing the current plan to build the Daya Bay nuclear power plant; he did emphasize that the design of the power plant will meet the world's highest safety standards, and indicated that the project is now in the detail design phase.

Prof. Xu also said that during the meeting with Jiang Xinxiong, the visitors presented him with some foreign literature on nuclear power generation, and openly expressed the concerns of Hong Kong residents about the Daya Bay power plant.

Observations at the Satellite Launch Center

"At the invitation of the Chinese Education Commission, 15 members of the Scholars Association of Hong Kong spent 9 days (from 2 August to 10 August) on a tight-schedule tour where they visited several Chinese facilities including the Xichang Satellite Launch Center, Sichuan University, Changzhou City and the Chinese Institute of Nuclear Science. The visitors exchanged ideas with Chinese representatives on the relationship between higher education and social, industrial, and economic development. Such exchanges were one of the main objectives of this trip." With this introduction, Prof. Xu proceeded to describe the results of this tour.

This delegation was the first group of visitors from Hong Kong ever invited to tour the world-famous Xichang Satellite Launch Center. "The impression I got from touring the Center is that most of the equipment there is made in China. The Center is highly efficient; the militarized management system and the thorough inspection procedures are impressive," Prof. Xu said. This reflects China's serious attitude toward high-technology development.

"Later, we visited Sichuan University, which recently had received a loan from the United Nations to purchase research equipment for graduate students; this equipment is of higher quality than that available at the two Science Institutions in Hong Kong." Prof. Xu has a special interest in research facilities at universities and colleges.

Changzhou was one of the key stops on this tour because it represents a typical example of successful inland industrial reform. The successful reform of the economic system of Changzhou's industries was attributed to the fact that many local businesses had evolved from subsidiaries of past administrative offices into independent enterprises with authority to make their own decisions. Over the years, Changzhou has become a city of many individual businesses; it has established a free market system as well as a new system whereby economic coordination and economic growth of towns and villages in the county are stimulated by urban economic activities.

Exchanging Experience on Higher Education

"We have learned from this tour that China is paying a great deal of attention to the correlation between higher education and economic development." This was the feeling expressed by members of the delegation after listening to a report by the deputy director of the Chinese Education Commission, He Dongchang, on China's education reform, and after a meeting with members of China's Higher Education Society.

During the discussion, He Dongchang pointed out that there is a tendency for Chinese students to relax their attitude toward learning once they have entered college. Their approach to solve this problem is by tightening the requirements; they also try to develop the students' ability to conduct independent research, to analyze and solve problems, and to explore and create new things. In addition, courses in the areas of organization and management are emphasized and special programs have designed for students with exceptional capabilities.

In the spirit of academic exchange, members of the Scholars Association also discussed the status of Hong Kong's higher education and its future prospects, and offered suggestions on education reform.

Achievements of China's Nuclear Research

After a visit with the director of the Chinese Academy of Sciences, Lu Jiaxi, the Hong Kong delegates were given a tour of the Chinese Institute of Nuclear Science and an introduction by director Sun Zuxin. "We were given a tour of the heavy water reactor, the isotope product exhibit room, the isotope

production line, the miniature reactor, and the serial accelerator. We were very impressed by the high level of technical capabilities and research activities at the Institute." Prof. Xu continued: "Over the past 30 years, the Institute has trained and delivered more than 3,000 nuclear scientists, engineers and specialists. Nuclear research has had a long history in China; through this tour we came to appreciate the rich experience and achievements of China's nuclear research."

In addition, the Institute also described for the delegation the status of the Qingshan Power Plant, and realizing that the safety issue of the power plant would be of particular interest, they presented the visitors with a collection of first-hand information on the subject.

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NATIONAL DEVELOPMENTS

BEIJING AREA S&T SITUATION DISCUSSED

Beijing BEIJING KEJI BAO in Chinese 20 Jun 86 p 1

[Report by Liu Huanfa [0491 3562 4099]: "Directions for Science and Technology Within the City District"]

[Text] How is science and technology within the city limits of Beijing going to "face up," how is it going to develop? Comrade Gao Yuan [7559 0626], deputy director of the municipal science and technology commission, spoke on this problem at a science and technology working conference in the city's eastern district.

He pointed out that science and technology in the Beijing urban area will be appropriate to the spirit of the response of the central authorities regarding plans for development in Beijing. It will be limited to functions of the nation's capital, will cater to urban and economic construction and to economic management in Beijing Municipality, will serve the central authorities, will serve the residents of the city, and will resolve many of the inconveniences in the lives of residents. Therefore, we will not only resolve technical problems for small and medium enterprises within the city proper, but will solve technical problems in the realm of circulation. There is also work in culture and education, water and energy conservation, environmental protection and hygiene, public facilities, and in modern urban management, all of which are inseparable from science and technology.

Comrade Gao Yuan also pointed out that development of the city cannot be apart from technical advances, that development of urban science and technology cannot be divorced from personnel, and that to solve the technical problems just discussed we must make full use of the scientific and technical advantages of the nation's capital. We must bring in more technical achievements and personnel from the "5th" science and technology army of Beijing. And especially for some of the urban enterprises and neighborhood enterprises, if they are to consider greater development they must have personnel who have access to all kinds of scientific and technical knowledge, and they must take appropriate care of scientists and technicians who are brought in, for only if personnel are satisfied can they be used fully, and will the economic and social results be very great. If in this point there are no unhealthy tendencies, then it can be accomplished without fear.

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CSO: 4008/2126

NATIONAL DEVELOPMENTS

S&T ACTIVITIES IN SHANGHAI BUSINESS DESCRIBED

Hong Kong LIAOWANG [OUTLOOK] in Chinese No 23, 9 Jun 86 pp 18-19

[Article by Shen Shiwei [3088 0013 4885] and Wu Oufei [6762 7743 7378]: "Shanghai High Technology Enterprises on the Rise"]

[Text] In the auditorium of the spacious Shanghai Exhibition Center a robot carrying flowers greeted visitors, saying "I am a robot and have a brain just like people!" It then extended itself freely and showed off the movements of bending, extending, holding up, grasping, and holding. It could also move forward, backward, left, and right and sing a tuneful song in a human voice.

This was a wonderful exhibition by a robot at the recent "Exhibition of New Technologies and New Industries" in Shanghai. This exhibition vividly displayed the abundant achievements Shanghai has obtained in the fields of high technology. Of the 670 new technologies displayed shown at the exhibition, the majority were of an international standard of the late 1970's and early 1980's. Some even belong in the international forefront, showing the bright future of Shanghai in developing its knowledge and technology intensive industries.

The Challenge of the New Technology

The revolutionary tide of new technology in the world that has arisen so abruptly has first affected the industrially important Shanghai, on the western edge of the Pacific, which faces a serious challenge. Traditional industries that have unreasonable production structures, are wasteful of energy, and consume many raw materials have been the most favored, while traditional industries themselves have been restrained by the dual constraints of technical obsolescence and space saturation. The former advantages are eroding, some name-brand products are losing their competitive capacity in both domestic and foreign markets, etc.

To meet this challenge, Shanghai has organized more than 1,600 specialists into undertaking large scale surveys, demonstrations, and forecasting to explore new strategies for the development of Shanghai's economy and society. Their unanimous opinion has been: to respond to major trends, to regulate industrial structures, to greatly develop knowledge and technology intensive new industries, and to use the new technologies to arm and transform

traditional industries. To this end, Shanghai Municipality has designated the seven high technologies of microelectronics, new materials, biological engineering, optical communications, lasers, marine engineering, and human simulation machinery to be the foci of development and to be allowed to take the lead in forming industries. This will consequently infuse the Shanghai economy with a new vitality.

Making the Most of Advantages

Regarding the development of high technologies, Shanghai is endowed with certain conditions: first of all, there is a powerful and abundant science research development contingent, there are more than 1,000 science research organizations in the city, more than 50 institutes and higher institutions, 550,000 scientists and technicians, and a group of high level academic leaders. In some high technology fields, Shanghai stands at the forefront in terms of the numbers and quality of people. At the same time, there is a rather good research and development base in Shanghai for the high technology fields, some higher technologies having started here domestically. Computers and new materials began to be studied and built here in the late 1950's. For example, integrated circuits and lasers began in the early 1960's, and genetic engineering and fiber optic communications started up in the mid-1970's, all of which began follow-up research soon after appearing internationally. In addition to this, Shanghai is the "center" of ocean, land, and air transportation, with a great deal of data flow. The newest international technical information can get to Shanghai quite quickly, which provides information resources for the development of high technology industries in Shanghai. By developing these advantages, Shanghai has the potential of being the leader in this country for developing high technology and for serving as a "pathfinding vanguard."

To develop high technology industries, Shanghai is currently adjusting industrial and product structures in a gradual and selective way, and in accordance with the requirements of less energy consumption, fewer materials used, fewer quantities shipped, fewer of the "three wastes," and of being highly technology intensive and having high added value to products, is compressing products that become extensive, controlling low-grade products, developing products of high technology, all of which allows Shanghai industries to change from the extensive model to an intensive one, and to change from primary reliance on material resources to primary reliance on technical advances.

Advances That Will Attract Notice

To open up high technology industries, the science research departments and enterprises of Shanghai are currently breaking through the restraints of "creating barriers" and of ownership by departments and have made remarkable advances in the areas of cooperating to handle problems and firming up the basis for science research development and industrialization:

A group of research achievements of advanced world standards have come into being, some of which have already "left" the laboratories. As for example the 4K-bit CMOS static RAM that was developed by the Metallurgy Institute,

Shanghai, of the Chinese Academy of Sciences that is undergoing testing. This chip has the advantages of low energy consumption and high resistance to interference, has attained the levels of the 1980's, and may be substituted for similar products from abroad. The major focus problem-solving project "single mode optical fiber technology" of the State Science and Technology Commission during the Sixth 5-Year Plan (1981-1985) is undergoing evaluation in Shanghai, which shows that the Chinese single mode optic fiber applied chemistry research has made great advances and that the research has entered the ranks of the world's advanced. The Shanghai Silica Glass Factory is about to undertake the production of conventional single mode optic fibers, which will provide the material basis for the industrialization of fiber optic communications. The liver cancer monoclonal clone antibody developed by units of the Shanghai Cellular Biology Institute of the Chinese Academy of Sciences is a major weapon against the never before controlled liver cancer. This progressive achievement in biological engineering occupies a leading position throughout the world.

To promote the transformation of high technology achievements into production forces, Shanghai is in the process of paying close attention to the building of a group of high technology intermediary experimental and developmental bases. Those among which that have been established in cooperation with the Chinese Academy of Sciences are the Shanghai Biological Experimental Base, the Chemical Materials Intermediate Experimental Base, the Large Scale Integrated Circuits Science Research and Development Base, and the Vegetable Irradiation Preservation Intermediate Experimental Research and Radiation Technology Base for Dissemination of Applications. The first phase project for the radiation base has been finished for the most part, the overall area of which is 4,000 sq m and which is equipped with radiation fields, loading fields, and control rooms. This base has begun trial operations. Planning is currently underway for the Cao-Jing Rivers microelectronics industrial area that has been called the "Shanghai Silicon Valley." This high technology industrial area will concentrate the computer, LSI, fiber optic communications, and laser industries to gradually form a "window" on Shanghai's high technology industries. Development companies for this new industrial area have already begun operations, and LSI base engineering has broken ground and started work.

Many science research units cooperate with factories to form research--intermediate testing--production "chains," which has speeded up the process of developing high technology industries. After units of the Shanghai microbiology institute completed research on using fixed yeasts to produce beer, they immediately undertook intermediate experimentation with the Shanghai Huaguang Beer Plant. They went on to use those findings in mass production, which allowed the time for the production of beer at this factory to be reduced from the original 21 days to 13 days, greatly improving the quantities of beer produced. In a few months, this biological engineering technology was disseminated to more than 10 beer plants in Shanghai and elsewhere.

Microelectronics, fiber optic communications, lasers, biological engineering, and marine engineering have already taken quick steps toward industrialization. Scientists and technicians from more than 100 research institutes and from higher institutions and enterprises have begun to

cooperate, disseminating more than 13,000 microcomputers into the professions of textiles, metallurgy, posts and telecommunications, light industry, transportation and shipping, chemical engineering, machinery, and broadcast television, successfully developing more than 1,000 applications projects, from which they have obtained clear results. At present, Shanghai has applied microcomputers in the establishment of 27 information banks of 8 different types, which has provided an information basis for strengthening overall control of economic activities. Fiber optic communications are at a particular early stage, where production capacity for optic fibers throughout the city has reached from 3,000 to 4,000 km. There is a certain scale of production for terminal equipment of all sorts and optoelectronic components. Fiber optic communications have begun to be applied in the fields of telephony, electric power, broadcast television, public safety, transportation, and data transmission. Laser technology has also begun to penetrate in the applied areas of steel plate cutting, soldering, and hole drilling. At the same time, laser medical instruments and laser diagnostic technology have begun to enter the medical field.

High technology depends upon traditional industry expanding its "area of permeability" to open up the fields for application. As Shanghai develops high technology it is paying attention to "grafting" and "injecting" new technology into traditional industries. In this way, on the one hand traditional industry is allowed to replace its "shell" and to glow with vigor, while at the same time allowing the products of high technology to have fields in which to be applied. From this, both gain. With the cooperation of factories, units at the Shanghai Academy of Textile Sciences have connected computers to the cloth machinery, which provides strict monitoring and management of the production process, leading to a great rise in product quality and production efficiency. Certain new materials have begun to enter traditional industries in Shanghai. In the process of developing special engineering plastics, units at the Shanghai Plastics Institute developed a modified polyformaldehyde chain link to substitute for stainless steel chain links, which when used in the more than 10 factories like the Shanghai Yimin Food Products Factory #1 and the Meilin Can Factory alone saved 10 tons of stainless steel. Currently, the production quantities of new materials such as structural composite materials, special high molecular materials, man-made crystals, and functional ceramics produced in Shanghai are more than one-third of output for the entire country.

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NATIONAL DEVELOPMENTS

XINJIANG TECHNOLOGY IMPORTS FOR 7TH FYP DETAILED

OW021148 Beijing XINHUA in English 1037 GMT 2 Oct 86

[Text] Beijing, 2 Oct (XINHUA)--By 1990, the Xinjiang Uygur Autonomous Region will have spent U.S.$162 million plus 486 million yuan to import 170 projects of foreign advanced technology, the ECONOMIC DAILY reported today.

The regional government decided that the first imported items will be those connected with the region's food, packaging and leather industries, the paper said.

The advanced technology will be introduced especially to the food industry in Kashi, Hetian and Xinyuan in southern Xinjiang to boost their milk and fruit products.

Sophisticated machines will be brought in to improve the region's fur and hide garment and shoe production. Also, techniques and equipment to produce hygienic soft packaging will be imported to help the region keep its surplus fruit fresh.

By the end of last year, the region had already imported 58 technological projects worth U.S.$37.9 million. An assembly line imported from Switzerland to produce hami-melon juice and jam enabled the residents to enjoy the soft drink made from the famous hami-melon for the first time in history.

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CSO: 4010/2002

NATIONAL DEVELOPMENTS

COMPUTER MANUFACTURING INDUSTRY TO BE DEVELOPED

OW101139 Beijing XINHUA in English 1036 GMT 10 Sep 86

[Text] Beijing, 10 Sep (XINHUA)--Over the next five years China will develop an electronics industry based on high technology software and computer manufacturing.

This decision was announced by Xie Gaojue, vice-minister of China's electronics industry, at a meeting here today which was attended by diplomatic envoys and company representatives from foreign countries based in China.

Computer manufacturing plants are now being built in Beijing, Shanghai and Wuxi. This will allow China to mass-produce integrated circuits, micro-computers and other micro-electronic products and to improve their quality, said the vice-minister.

Xie said China has already mastered the latest computer technology and is now doing research into more advanced applications of the technology.

Great efforts will be made to develop communications equipment using satellite, microwave and fiber optics. China also wants to produce more digital switching equipment and computer terminals, Xie said.

So far, there are more than 135,000 computers of different types in the country. The Chinese-made "Great Wall 0520" micro-computer and Chinese character processing software are up to the advanced international standards. China has also succeeded in developing a supercomputer capable of making 100 million calculations per second.

In the future, the vice-minister said, efforts will be made to popularize the use of computers, train skilled personnel and develop better information services.

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NATIONAL DEVELOPMENTS

TIANJIN SETS UP TECHNOLOGY DEVELOPMENT GROUP

OW050536 Beijing XINHUA in English 0011 GMT 5 Sep 86

[Text] Tianjin, 5 Sep (XINHUA)--Tianjin has set up its first new technology development group together with firms in Beijing and Jiangsu Province.

This is one of the latest moves taken by this leading industrial and port city in north China to broaden its economic ties with other parts of the country, officials here said.

The 40 members of the Tianjin New Technology Development Group will work together to design and develop new products, run joint ventures using new technology and spearhead the use of new technology and equipment.

Ling Zhaoyuan, chairman of the group's board of directors, said it "will help raise China's scientific and technical level."

The group has decided to start some 90 cooperation projects. Firms of the United States, Britain, Japan, Singapore, Canada, Federal Germany and France will participate in 26 of these.

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CSO: 4010/2002

NATIONAL DEVELOPMENTS

WORK OF CHINA S&T ASSOCIATIONS APPLAUDED

Hong Kong LIAOWANG [OUTLOOK] in Chinese No 25, 23 June 86 pp 12-13

[Text] The 3d Congress of the China Science and Technology Association that opened so ceremoniously, where more than 1,800 representatives from all over the country gathered in the capital, could also be called a "conference of science and technology heroes."

The China Science and Technology Association, made up of national learned societies (associations, symposia) and local science associations, is a public organization of Chinese scientific and technical workers, and is the link between the party and the government on the one hand and the scientists and technicians on the other, and is an aide to the development of science and technology.

The aims of the China Science and Technology Association are to promote the prosperity and development of science and technology, to promote the distribution and application of science and technology, to promote the maturity and improvement of science and technology personnel, and to make contributions to improving scientific and cultural levels for all Chinese people.

The national congress of the China Science and Technology Association meets once each 5 years. At the second national congress, held in 1980, Comrade Hu Yaobang made an important speech in which he pointed out that "the S&T Association is an organization for scientists and scientific and technical workers," and "on the road of the advance guard of modernization, the S&T Association holds an important position." He hoped that in the great mission of the S&T Association to open up intellectual resources, they would "play a great historical role."

At present, there are 138 national societies (associations, symposia) in the China S&T Association, with 1.8 million members, as well as 3.5 million Science Popularization Association members distributed throughout towns and townships. For 6 years now, they have done much work in keeping with the needs of trend developments and in promoting the prosperity and popularization of science and technology. Chief among this work has been:

1. Centering on the strategic points of the 12th CPC Congress and the primary topics for research established by the state, they have organized scientific and technical workers to develop in all sorts of ways multi-discipline, comprehensive academic exchanges, have investigated development strategies, and have provided a scientific basis that has allowed the scholastic viewpoint to be changed into decision making thinking. More than 20 associations of Chinese agriculture, forestry, and water conservancy and regional science associations have organized comprehensive academic discussions regarding development strategies for agriculture in the Huanghai-Huaihe area, the northern arid and semi-arid regions, the Nansha islands, and the Shanghai economic zones. They have proposed strategic thinking and technical measures based on the differing natural conditions and levels of economic development regarding development of large scale agriculture in accordance with local conditions and preserving the agricultural ecological environment, and regarding adjustment of rural production structures, all of which have promoted the development of the rural economy.

The China Energy Resources Symposium arranged for more than 500 specialists to draft the "Recommendations for an Outline of China's Energy Resources Policy" after scholastic conferences. This group proposed development strategies for energy resources that lay equal stress on development and energy conservation and that have gained the respect of relevant state departments.

To meet the challenge of the new technology revolution, the China S&T Association has joined with other relevant departments to arrange for 72 associations and provincial and municipal S&T associations in Liaoning and elsewhere to exhibit Chinese research in the year 2000. They have amassed 13 million words of materials for reference by relevant departments in formulating long term plans. This abrupt development of scholastic activities has also accelerated developments in the rising new disciplines, fringe disciplines, and crossover sciences of system sciences, ecological sciences, environmental sciences, and biological engineering.

2. With the support and guidance of science associations and societies at all levels, more than 41,000 town and township science popularization associations and of more than 60,000 special technology symposia have popularized and applied technologies for vast numbers of farmers through the various modes of science popularization publicity, technology contracts, technical services, technical demonstrations, and technical training. They have helped farmers rid themselves of poverty and attain wealth, have developed the commodity economy, and have served as "intermediaries." This is especially true for the various public special technology symposia set up in the countryside throughout China, where those proficient in the technology take charge and motivate the rural households to undertake specialized production and to open up new industries. Some have developed into technical and economic associations, which have stimulated the adjustment of rural production structures, and allowed agricultural production to change toward specialization, toward commodities, and toward modernization, as well as exhibit a strong vitality. For 6 years now, S&T associations at all levels have held together with relevant departments all kinds of farmer technical training classes, which has allowed 80 million people to receive short-term instruction. National societies and provincial and municipal S&T associations

have sponsored more than 76 different science popularizations periodicals, for each issue distributing 10 million copies; 42 publicly distributed science and technology journals, each issue distributing 8.8 copies; science popularization activities such as popularization publications and live demonstrations have also had new development. The science education film "The Wizard's Tricks," produced by the Beijing Science Education Film Company with the aid of the Chinese Institute of Science Popularization and Creativity has been broadly welcomed by the public, 1,400 copies having been distributed.

3. S&T associations at all levels have made full use of the characteristics of the many science disciplines, lateral relations, and unconventional positions to energetically develop scientific and technical consulting services, accelerate the socialization of science and technology, and to generate broad-based social and economic results. With the authority of relevant departments, the Baogang Advisory Commission organized by the Shanghai Municipal S&T Association made more than 60 recommendations, among which the demonstration and decision making consultation regarding starting the second stage engineering of the water channeling plan has moved construction at Baogang smoothly along, and has been praised by relevant sectors of the central authorities and by the Shanghai Municipal S&T Commission. During the period from 1984 through 1985, the Anhui Provincial S&T Commission provided consulting services for 200 small and medium enterprises, completing in all 2,700 consultations of all types, and creating a production value of 630 million yuan.

4. Scientific and technical training activities of all kinds and levels were begun. Over the last 6 years, 200,000 people annually have studied at training classes and lectures on new technologies that have been held primarily for mid-level scientists and technicians by national and provincial level societies. And local S&T associations have restored or newly built 86 science and technology extended training institutions, allowing 400,000 scientists and technicians to receive a more systematic instruction. Science associations at all levels have also begun general technology and new technology training activities of many different kinds. There are for example full scale broadcasts and television lectures on quality control, systems engineering, mechanized drafting, electronic technology, and microcomputer applications, with audiences of more than 20 million people. Activities sponsored by the China S&T Association together with relevant departments, such as "Lectures on the New Technology Revolution," "the mayor's study class," and "Lecturers on Modern Knowledge," have allowed more than 100,000 leading cadre of all levels to learn appropriate scientific and technical and management knowledge. There have also been 2 national youth invention and creativity competitions and science conferences; and 100,000 youth have been able to participate in computer science and technology activities.

5. There has been a wide ranging initiation of international academic exchanges and scientific and technical cooperation, and an opening of channels for scientific and technical exchanges among peoples. More than 10,000 foreign specialists have participated. By meeting with nearly 20,000 foreign and overseas Chinese scholars and holding more than 1,000 academic public lectures, scientists and technicians in this country have been allowed to know of international scientific and technical information in a timely manner. For

some years now, relevant societies have sent forth more than 1,000 scientists and technicians abroad for observation, teaching, and further study. The "Public Lectures on Traveling Abroad" sponsored by the Chinese Medical Society has invited those who have traveled abroad to speak on new foreign technology and information, by which when one person goes abroad, many benefit. The rightful positions of the China S&T Association on the council of the International Federation of Scientists and of the World Federation of Engineering Organizations have been restored, relevant societies have become part of 88 international science and technology scholastic organizations, some 200 scientists among them taking on leadership positions, and contacts have been established with more than 100 science and technology organizations in 40 countries and regions. The "Exhibition of Chinese Ancient and Traditional Technologies" organized by the China S&T Association has appeared in both Canada and the United States, which has expanded its international influence.

6. They have played a central role in protecting the legal rights of scientists and technicians and in helping the party to implement policies for intellectuals. In recent years, S&T associations at all levels have surveyed and studied the conditions regarding implementation of policies toward scientists and technicians and regarding fulfillment of their functions and have reflected the opinions and needs of scientists and technicians to the party and the government. Also, they have done beneficial work in improving working conditions and living conditions for scientists and technicians and have promoted the rational employment of personnel. The science and technology extracts compiled by the S&T associations of Shanxi, Fujian, and Hubei provinces have furnished important reference materials for the party and the government regarding the promotion of personnel. The "Standards of Science Morality for Scientists and Technicians in the Capital" proposed by Mao Yisheng [5403 0110 0581] and 103 scientists has been answered by the majority of members. In collaboration with the State Nationalities Commission and the Ministry of Labor and Personnel, the China S&T Association awarded certificates of honor to 32 scientists and technicians who have worked in minority nationality and frontier areas for more than 30 years, and commemorated 1,800 advanced scientists and technicians among them, encouraging their spirit to build the frontiers.

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NATIONAL DEVELOPMENTS

MORE ATTENTION URGED FOR HEAT TREATMENT TECHNOLOGY

Beijing ZHONGGUO JIXIE BAO in Chinese 5 Aug 86 p 2

[Report by Liu Dai [0491 6610], secretary-general, Conference on Heat Treatment, Chinese Association of Mechanical Engineering: "Problems in the Development of Heat Treatment Manufacturing Technology"]

[Text] To allow the machinery industry in this country to attain the current production levels of advanced industrial countries by the end of this century, we must change the situation regarding backward techniques in the machinery industry as quickly as possible. Here, I would like to discuss some of the problems in the development of heat treatment production technology.

Adopt vigorous measures to develop advanced heat treatment equipment and limit the production of backward equipment.

At present, the heat treatment production technology in this country is only up to the level abroad during the 1950's or 1960's, a situation evidenced by obsolete equipment, the inability to control the production process, deficient quality of components, and a short life.

Among the 100,000 pieces of equipment in the heat treatment trade in this country, there are 10 percent too few protective atmospheric furnaces and vacuum heat treatment furnaces, the majority of which are box furnaces and well furnaces for heating in an oxydizing atmosphere, as well as old style highly energy consuming salt bath furnaces, induction heating equipment, and well-type carburizing furnaces. If by the end of this century we are to attain current foreign levels of heat treatment manufacture, we must at least eliminate half of our old obsolete equipment. Always in consideration of the equipment utilization rate and production capacity, beginning now we must use 1,000 new pieces of equipment annually to replace 300 pieces of obsolete equipment. Obviously, we cannot use imported equipment to renew and replace. Although at present there are some electric furnace plants that can produce a small quantity of high quality equipment, but whether from the aspects of quality, variety of product, or quantity, we are far from being able to satisfy the need. For various reasons, there is still great demand for the old-style equipment. Electric furnace manufacturing plants are willing to manufacture this high profit equipment that has a low requirement for technology. Therefore, we are currently maintaining annual output of 2,000

old style pieces of equipment, which puts an ever increasing burden upon the renewal and replacement of heat treatment equipment. This situation should not continue.

The reasons leading to this situation are numerous. First of all, the utilization rate for heat treatment equipment in this country is low, to which we add the simplicity of the equipment and ease in maintenance, the results of which are that we seldom discard it or replace it. Second, we have not yet formed the ability to manufacture advanced equipment. Aside from reasons of technology, low profit is also an important consideration, to which is added the fact that the technology is not mature and the quality of the furnaces is not high, which increase the burden of maintenance for the manufacturing plant. Third, technology levels and the standards of technique are low, so motivation is lacking for the replacement of heat treatment equipment.

Based on these conditions, relevant leading departments must adopt vigorous measures, and quickly turn this situation around. First, during the period of the Seventh 5-Year Plan, we should develop the ability to produce advanced heat treating equipment, and fully use and import advanced foreign technology or undertake cooperative production. We should also use the means of tax revenue to encourage electric furnace plants to produce advanced equipment and limit production of obsolete equipment. At the same time, there should be surveys of the product types and quantities of advanced equipment needed by various machinery commodity businesses, and key enterprises should arrange for equipment replacement. We should arrange jointly with relevant industrial departments for the manufacture of different kinds of materials for the protection of atmospheric gas resources and techniques to ensure the normal operation of advanced equipment. These are all basic conditions for the acceleration of equipment replacement and renewal.

Strengthen Theoretical Research Into Heat Treatment Techniques

Enhancement of heat treatment theoretical research is another important problem in improving the level of heat treatment production technology. Technique is technology, and in many foreign languages 'technique' and 'technology' are the same word. The development of techniques has given a great push to production forces, as for example with the appearance of vacuum heat treatment, by which not only can commodity performance be doubled in performance, but in surface non-oxidizing decarbonization, distortion is small, which greatly reduces the grinding process and lowers costs. Consequently, it may be said that there is still a tendency to neglect technique, which seriously affects the improvement of machinery product quality. If we were to say that state allocations to research in techniques during the "7th Five Year Plan" are pitifully low, that would not do justice to the mission of the entire machinery industry. It would appear that science research expenses can only be used in new, trendy projects, while urgently needed research in traditional basic techniques is still not being seen. That being so, it is just the level of these techniques that is the embodiment of the machinery manufacturing capability in this country. In technique research, we should strengthen intermediary experimental links and use the results from the laboratories in production as quickly as possible. But we should also guard against yet another tendency, that being the sole

development of topics dependent upon commodities, for this is simply to concern ourselves only with the economic results directly in front of us. It is quite possible to shatter the research into technique theory that needed strengthening in the first place, thereby increasing the gap between foreign levels of technique and ours. We should not treat all key technique institutes the same way, cutting off all state allocated operating expenses uniformly and forcing institutes to abandon theoretical research into technique. Quite the contrary, the state should enhance and foster them, should renew the equipment of these institutes, use them to import and absorb advanced foreign technology, and join with higher institutions to assume the responsibility for research and development of heat treatment techniques and equipment. We must not imagine that we will only copy after the lead of others, but rather should be taking the lead in certain fields ourselves.

Set Up Some High Quality Heat Treatment Points for a Narrow Range of Techniques

Enhancing specialized production is an effective way of arranging for modernized heat treatment manufacturing. In organizing heat treatment processing plants, we should not only pay attention to the improvement of equipment utilization rates, but should also have advanced equipment and use advanced techniques to better promote technology advances throughout the profession. Our existing heat treatment plants could for the most part manage to be "all-round" plants for various techniques, and although equipment utilization rates would be high, standards of equipment and technique would not be high. Foreign heat treatment specialty plants are not often large scale and they can only do certain kinds of techniques, but their standards for equipment and techniques are higher. Currently, this kind of "all purpose" heat treatment plant in this country is possibly necessary to serve small and medium plants in this regard, but we should also establish some high quality heat treatment plant sites that are limited in the scope of their techniques, so that they might find a place in the heat treatment of key components of medium to large scale machinery plants, and so that they can promote the improvement of levels of technology throughout the profession.

The machinery industry in this country shoulders the enormous burden of providing excellent equipment for all industrial sectors. Heat treatment production technology that is intimately related to machinery product quality suffers greatly in comparison with advanced foreign standards. If we are not sufficiently aware of this, we cannot make immediate use of vigorous measures, which is quite dangerous and is certain to eventually affect the modernization of the machinery industry.

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NATIONAL DEVELOPMENTS

POLICY OF NOT TESTING IN MIDDLE SCHOOL TRIED OUT

Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 22 Aug 86 p 4

[Report by Xiao Guangen [5618 7070 2704]: "Director of Shanghai College of Communications Calls For Change in Admission System"]

[Text] Recently, the director of the Shanghai Jiaotong College, Weng Shilie [5040 0670 3525], proposed that to change the admissions system the schools must be given even greater autonomy.

Weng Shilie said that abuses in the admission system that relies solely on test results and records in choosing students are becoming more and more obvious. This is not advantageous to letting talent show itself, for there is no way to fully investigate the natural gifts, intellect, quality, and potential for development of students, and in fact it is difficult to avoid stifling talent. The unified examination constitutes a kind of baton that directs students to one-sidedly seek entrance into a higher school, even to the extent that many middle schools conclude their curricula a term ahead of time and spend the time studying for the upcoming exam. This makes a minority of outstanding students waste their time after having already completed their studies ahead of time. In the past, we often criticized middle schools for one-sidedly seeking entrance into higher schools, saying that it was not fair. As we understand it, many middle school leaders have long felt that to move to keep up with the high school examinations would be a mistake for the outstanding students, and that they urgently hope there will be a change in the admission system for the higher level schools. This would create a situation conducive to the early maturing of outstanding students.

Weng Shilie told reporters that regarding changes in the admission system, for some years now Jiaotong College has been earnestly exploring the situation. In 1980 they requested approval from relevant departments for Jiaotong College to admit students on testing from high schools after not testing when at affiliated middle schools. In 1984 they again requested admitting through testing 77 students from affiliated middle schools who had not earlier tested. But it was only in 1985 that they accepted 220 students from Shanghai and other places who had not tested, even entering school one-half year early so that they could have a good foundation for study. The results have been good. After summer vacation this year, 70 of them will be able to enter at the third year level, one year ahead of students in their class. Some of these

exploratory changes at Jiaotong College were first cleared with higher authorities and relevant departments, while some were approved by higher authorities only after initial successes. And of course some were undertaken first and reported later, where reports to the relevant departments were inadequate. However, right from the beginning, leaders and teachers at the middle school welcomed this experiment. This year, the number of outstanding students entered for examinations into Jiaotong College throughout the country is unprecedented, greatly exceeding the limit for acceptance without examination as set by higher authorities, so some very qualified middle school students will not be able to be selected.

Weng Shilie said that the authority with which to change the school admission system also includes the possibility that for truly outstanding students, when the middle school recommends or when the university is admitting, relevant restrictions can be overcome. It is, however, still difficult to select people without anything to recommend them.

12586
CSO: 4008/2126

NATIONAL DEVELOPMENTS

SHANGHAI SHIPBUILDING EXPANSION NOTED

Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 15 Aug 86 p 2

[Text] The Shanghai shipbuilding industry has reduced the gap between them and international standards, and can now build ships that comply with any international standard and that navigate in any navigational area. Their manufacturing capabilities and techniques already approach international advanced standards.

According to a report in WENHUI BAO, the variety of ships built by the Shanghai shipbuilding industry has developed from cargo ships, bulk cargo ships, oil tankers, and multi-purpose ships to exclusively containerized, multi-purpose, rolled container, three-way, and special types of ships that are structurally complex and highly technical. Ship tonnage has developed from the 20,000 ton class to the 40,000 and 60,000 ton classes. Shanghai has also cooperated abroad to design a 29,900 ton net oil tanker, a 42,000 ton bulk cargo ship, and a 64,000 ton Panama-type bulk cargo ship. Among products and equipment that are different kinds of ships, main and auxiliary engines, and shipboard instrumentation and power, 57 products have received state gold and silver medals for quality, as well as ministry and municipal awards for outstanding quality. Seventeen items have received national level awards for science and technology advancements, and 8 items have been awarded national level awards for national defense use science and technology advancements.

In recent years, the Shanghai shipbuilding industry has imported well-known manufacturing technologies from Denmark, Sweden, and Japan, which after absorption, assimilation, and innovation, have continued to improve the international extent of imported products and equipment. In addition to particular products, the rate of national production of component parts and parts of systems has reached from 60 to 70 percent. At the same time, some shipbuilding plants have learned from foreign management experiences, have combined the characteristics of the Shanghai shipbuilding industry, and have applied CAD, CAM, and computer-aided management to improve the levels of technical management and operations management. All major shipbuilding factories have expanded their berths and have added area to loading and welding platforms and length to their docks. The have enhanced their capacity for crane transport and have replaced steel processing and welding equipment, which allows them to manufacture various large tonnage ships.

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NATIONAL DEVELOPMENTS

ROLE OF SOFT SCIENCE IN MODERN CHINA DISCUSSED

'Spark' Plans Included

Beijing LIAOWANG [OUTLOOK] OVERSEAS EDITION in Chinese No 32 1 Aug 86 pp8-9

[Article by Chen Siyi [7115 0934 4135] and Zhang Zhichu [1728 2535 2806]: "Leaders and Specialists Discuss the Soft Sciences and the Modernization of Decision Making"]

[Text] The first Chinese "National Soft Sciences Working Conference" obtained predicted results and generated a rather great impact. One reason for this was that those participating in the conference were not only soft science specialists, but also the leaders of the decision making bodies to which they correspond, and some held qualifications in both areas. During the 5-day meeting, people took part in multifaceted, ardent, and candid and sincere conversations, which consequently produced a deeply relevant topic: that the democratic and scientific nature of decision making is an important item in the restructuring of the political system.

On the afternoon of 31 July, the editorial department of this publication invited some of the participants to discuss how to develop Chinese soft science research and the democratic and scientific nature of decision making. We have arranged the results of that discussion as follows:

New Topics Facing Soft Science Research

Wu Mingyu [0702 2494 3842], deputy director of the State Science and Technology Commission: the democratic and scientific nature of decision making has become an important topic in the restructuring of the political system, and soft science research has an even greater sense of timeliness, of mission, and of responsibility. There are at least the following major topics before us at present, topics that require us to expend a great deal of effort in study: there are many articles to be written regarding the study of the future for China in the year 2000. Deng Xiaoping has proposed that by the end of the century, the lives of the Chinese people will be comfortably well off, so what kinds of changes will there be by that time in what people eat, where they live, what they wear, and what they do? What will Chinese industrial structures be like? What will energy resource structures be like? What kinds of changes are likely to take place along the coast, inland, in the major

cities, and among industrial groups? These overall problems require us to make decisive plans.

There Is Also An Evolution of Concept

Hu Ping [5170 1627], director of the Science and Technology Promotion and Development Center of the State Science and Technology Commission: We should change the traditional method by which we have been accustomed to rely on the positions and authority of leaders themselves to make decisions, and should go further to establish an entire set of decision making programs and decision making structures for science. This is because the empirical decision making of the past had been developed from a small production basis. In this aspect we are saddled with immense burdens. One is the burden of the traditional concept of 3,000 years of small production; another is the burden of a lack of democracy over the past 30 years; and another is the burden of an anarchism generated by the ten years of "cultural revolution." Both the rather common situation over those 30 years where what one person said was what counted, that concept of relying on experience and authority in decision making, and the situation over the 10 years of the "cultural revolution" in which what anyone said did not count, that anarchistic thinking whereby people did what they wanted, are after all the thinking of small producers.

Science decision making was established on the basis of large production, and has been established on the basis of modern science and technology. If there is no fundamental evolution of concept, then the democratic and scientific nature of decision making cannot be achieved. For example, some of those in authority in departments and localities are used to proceeding from the narrow confines of the advantages for that particular department and that particular region. They pay no attention to the bigger picture, which is thus a small producer's concept. And as another example, soft science research is an exploration of what is not yet known. It can only respect the facts and revere the truth, but leaders of some departments and localities are still accustomed to the empirical decision making of small producers. They frequently require that soft science research bend to their own intentions or comply with their own ideas. Done like this, there is no way to have scientific decision making.

There Must Be Guarantees of Democracy

Wu Xiang [0702 6272], deputy director of the State Council Rural Development and Research Center: Beginning before the cultural revolution, the non-democratic spirit that developed maliciously during the cultural revolution has seriously obstructed the democratic and scientific nature of decision making. What one person says goes, everything is dealt with in the same way, everything is done without thinking, all in a rush-- you can see it everywhere and it is hard to counter in such numbers.

The democratic and scientific natures of decision making are inseparable. The "May 4th" movement mentioned "Mr. De" (democracy) together with "Mr. Sai" (science). Today we still need these two gentlemen. If decision making is to be scientific, it must have democratic guarantees to allow scientists the environment in which to independently carry out research, to not be aware of

the feelings of the leaders, and to not be swayed by the intervention of authority. This then requires that leaders at all levels be prepared to disregard the feelings of leaders above them, and rather to determine the nature of a problem according to the actual situation.

Soft Science Research Leads to Correct Decision Making

Pei Yingwu [5952 5391 2976], State Planning Commission commission member: Beginning in 1983, the State Science and Technology, Planning, and Economics Commissions organized study of some 10 major technology policies, and after more than 2 years, the several thousand well-known specialists, scholars, and leading cadre and practical workers from all departments who took part in this finally came up with the essentials of technology policies in 12 major areas. This was the most systematic and largest scale study of technology policy since the founding of the PRC. The State Planning Commission closely integrated the essential substance of these technology policies into planning for the Seventh 5-Year Plan (1981-1985) to form industrial policies and technology transformation plans for the Seventh 5-Year Plan. Regarding directions of technology development, they selected technologies, limited technologies, and phased out technologies, all with clear provisions based on scientific theory. This has allowed planning for technology transformation during the Seventh 5-Year Plan to be greatly advanced along the lines of the integration of economics with science and technology. Studies of Shanghai economic development strategies are a successful example of soft science research providing a scientific demonstration for accurate decision making. During the months of September and October 1984, and following the directive of Premier Zhao Ziyang, the State Council Survey and Research Group, together with the Shanghai Municipal Science and Technology Commission and the municipal government, organized several hundred specialists and scholars together with certain leaders and practical workers to do a large scale, systematic survey and study. They did repeated scientific demonstrations and proposed a report outline of Shanghai economic development strategies, which received the approval of leaders in the Central Committee and State Council.

In the process of the survey and research, there were two different programs. One required that Shanghai develop as an industrial base area to a greater degree, where its primary goal would be a quadrupling by the year 2000 of the Shanghai Municipality agricultural and industrial gross output value for 1980. In this way, during the period of the Seventh 5-Year Plan there would be a 72 billion yuan investment, energy resources, transportation, and shipping would be even more strained and the backward condition of the basic equipment of the city would become even more serious, and it would be hard to improve the environmental deterioration. But also, the advantages of Shanghai--its being a commercial center, science and technology center, important financial center, information center, seaport city, link in the open-door policy, and as a full and varied industrial base--would still not be fully developed; this made what should have been an aspect worth evaluating in the drive toward modernization be demoted to the position of an ordinary city. After exhausting scientific demonstrations, the following direction for development was finally decided upon: to build Shanghai into an open, multi-purpose modern socialist city having reasonable industrial structures, advanced science and technology, and a high degree of civilization.

Viewed from the work described above, an accurate policy must be certain to be the result of a great amount of scientific study and demonstration. Without soft science research, it would have been difficult to have made the accurate decisions in time.

As the Restructuring Needs the Hard Sciences, Even More Does It Need the Soft Sciences

Yu Jingyuan [0060 2529 0337], Assistant Institute Director, Institute No 710, Ministry of Aeronautics: Over the historical period of the full restructuring, China not only needs the hard sciences, but also needs the soft sciences, and to a certain degree needs the soft sciences even more. For example, the primary functions of the "national financial system control model" established by this institute is to ascertain appropriate rates of accumulation; calculate the amounts of currency circulating in the marketplace; undertake economic forecasting, and financial decision making simulations. After forecasting tests through the 2 years of 1983 and 1984, errors for this model did not exceed 5 percent, which meets and exceeds the accuracy of similar international models, and the model was proven to be an applications model that nears reality.

During actual work, I felt that if we were to hasten the modernization of decision making, we would have to implement true democracy, for without it decision making could not be scientific, and might even be greatly in error; if not scientific, decision making cannot represent the basic advantages of the people, nor could we speak of democracy. The two are mutually complementary, and neither can be absent.

Develop Cautionary Advising

Zhang Pan [1728 4323], deputy general secretary of the State Council Economic, Technological, and Social Development Center: Advising primarily serves decision making, and as soft science research, consulting that is predicting and cautionary is very valuable. For example, we recently did some surveys of population growth over the last year or two, and repeatedly warned people that population growth must be strictly controlled or our efforts over the last few years would be in vain, and the goal of families being well off by the end of the century would be difficult to attain. This problem has attracted the attention of the state. Naturally, cautionary advice of this sort can be risky at times, but if risk decision making is to be successful, then we must rely fully on the scientific demonstrations of advising.

There Should Also Be "Spark Plans" for Soft Science

Yang Jike [2799 4764 3784], deputy governor of Anhui Province: I would recommend that the State Science and Technology Commission formulate a "spark plan" for soft science research. During the current development of the Chinese economy and of society, scientific decisions need to be made about many problems, as for example questions of foodstuffs, population questions, environmental questions, etc. To this end we must undertake scientific studies before decision making. These studies should of course be done by

relevant government departments, and the science and technology commissions cannot help but organize their efforts to work in parallel with the studies of relevant government departments. In this way there would be at least two plans provided to leaders for their selection, where either the best could be chosen or the best could be combined from each and the Central Committee would formulate the final principles. The People's Congress would formulate laws and regulations, and the government would draw up plans and rules, which would then implement the decisions made.

Establish Two Advising Systems, Internal and External

Liu Ji [0491 0679], vice chairman of the Shanghai Science and Technology Coordinating Commission: With breakthroughs in the democratic and scientific nature of decision making, it is possible to establish a political system that fully exploits the superiorities of socialism. As for example in the past, when we had the streamlining of the military and the government, the streamlining of the government and delegation of authority, etc., where to undertake these kinds of reforms in the area of political systems is undoubtedly in the right direction. However, because we lacked strict studies from the soft sciences, the streamlining did not proceed from the functions of government departments, and although we established a highly effective, self controlling system, its goals have been quantitative. As a result, what are invariably cut first are brain trust structures and feedback structures. So the main problems for China's administrative structures have been overstaffing of system personnel, where the quality has not been high, and where what needs to be strengthened are just those brain trust structures and feedback structures.

When making decisions, leaders listen to the opinions of specialists and should distinguish the advice of internal specialists from that of external specialists. The advice of internal specialists is very significant, but because they are directly subordinate to department leaders, it is unavoidable that they would be affected by information and opinions from leaders. There can even be administrative interference and the likelihood of losing an impartial, objective perspective. Therefore, we must also seek the advice of external experts. The advice of external experts is not only more likely to be impartial, but can also better reflect the opinions and needs of various aspects of society, and is blessed with a comprehensive consideration of the situation. In general, we would hope that when leaders are making decisions, they would at least have two kinds of reports: the suggestions of internal specialists and the evaluations of external experts. The virtues of both would clarify the situation, and errors in decision making might be avoided.

There Should Be Great Proficiency About Soft Science Studies

Feng Zhijun [7458 0037 3182], institute director, Shanghai Institute of the Study of Science: There must be great proficiency in soft science studies. This great proficiency is first manifest in the scientific nature of research methods. The considerable progress made by modern natural sciences, and especially the harmonious convergence of the natural sciences with the social sciences, has laid the foundation for great proficiency in the soft sciences. This is primarily exhibited in four areas:

First, the objects of study in the soft sciences are usually non-linear, fuzzy, dispersed, random, and spontaneous, and the armory of the modern natural sciences has not provided powerful weapons to resolve these problems, while new advances in the modern natural sciences have provided possibilities.

Second, constant advances in computer technology, and especially the continued maturing of emulation, expert advising systems, and systems dynamic modeling have provided extremely good technical means for soft science studies.

Third, the research achievements of control theory, information theory, systems theory, dissipation structures theory, coordination theory, and even the research achievements of disorder theories, have provided effective tools for studying sequentially organized problems and for establishing the logical and mathematic models for decision making;

Fourth, developments in psychology, social psychology, and other fields of the social sciences have provided valuable analytical means for studying the psychological structures and psychological process of decision making.

Having excellent scientific tools is certainly not the equivalent of being able to solve practical problems, for great proficiency is still needed to solve the real problems in this country. The research achievements of the soft sciences should be as complete, quantitative, time efficient, tolerant, and hierarchical as possible, and they should make use of the three techniques of logical models, mathematic models, and emulation technology to allow the level of soft science studies to rise even higher.

Soft Sciences Personnel Should Be Respected and Fostered

Zhang Bihui [1728 4310 2547], assistant academy director, Huazhong Engineering Academy: Soft science is the product of the cross fertilization of many science disciplines. It is comprehensive research that transcends departments and disciplines, and the object of which is also largely a macroscopic system concerned with the national economy, society, and science and technology. For this reason, soft scientists are hard to come by and leaders at all levels should pay them special respect. But the situation until now has been that scientists and technicians in the hard sciences are favored over those of the soft sciences, and soft science personnel have invariably been labeled as "generalists." Actually, soft science uses the theories and methods of many sciences, it uses advanced calculations and techniques, and through logical, mathematic, and emulation models combines the qualitative with the quantitative to propose optimal programs for the resolution of various problems, which makes it very useful. As society revolves so quickly, a new way of thinking or the decisions of a science can revive a particular industry and can make a unit rise to prosperity. Naturally, this must be done through the exploratory and creative arduous efforts of soft science personnel. People of this type will generally have a background in the natural sciences, a wide ranging knowledge base, and a strong analytical, integrating, and resilient capacity. This kind of person is conditioned through a long period

of practice, and cannot be summoned up at will. Therefore, besides respecting these people, we should also include the fostering of soft science personnel in the planning of the higher institutions. One part of this planning is the cultivation of dual role students.

Soft Science Situation

Beijing LIAOWANG [OUTLOOK] OVERSEAS EDITION in Chinese No 32, 11 Aug 86 pp10-11

[Text] Soft science is a product of the mutual cross fertilization and permeation of the natural sciences, engineering technology, and the social sciences, and primarily studies the coordinated development of society, the economy, and science and technology. It simplifies policy problems in modern society, serving the scientific nature of decision making and the modernization of management.

In recent years, soft science studies in this country have developed quickly. In the survey organized this year by the Office of Policy of the State Science and Technology Commission of domestic soft science research, the situation was found to be as follows:

Soft Science in China Is Beginning to Take Shape

According to a preliminary survey, there are 420 organizations throughout the country engaged in soft science research, among which 25.6 percent belong to various national departments, 34.3 percent are affiliated with the provinces, municipalities, and autonomous regions, and 40.1 percent with the higher institutions.

There are approximately 150,000 people engaged in soft science research, among whom 10.3 percent are high level research personnel and 35.2 percent are middle level research personnel.

Among the 1,735 soft science projects which have been completed, 29 percent were completed by research organizations of national departments, 35.2 percent were done in provinces, municipalities, and autonomous regions, and 35.8 percent were done in the system of higher institutions.

Soft Science Research Is Primarily Characterized in the Following Way

A group of professional soft science research organizations have been established to serve higher echelon decision making. There are, for example, the State Council Economic, Technological, and Social Development Research Center, the Rural Development Research Center, the System Restructuring

Research Center, the State Planning Commission Forecasting Center, the State Science and Technology Commission Science and Technology Promotion and Development Research Center, and the State Economics Commission Information Center.

Many provincial and municipal laboratories that are administrative units for organizations have been expanded to be specialized soft science research organizations, as for example the Provincial and Municipal Technology and Economic Development Research Center, the Institute of Provincial and Municipal Development Strategies and Policies, and the Economic Research Center. These formats specialize in policy research, which allows for the situation in which their organizations are apart from administrative systems, guaranteeing the position of soft science in decision making links.

There has been a true integration of the cross fertilization between the natural sciences and the social sciences, and a group of natural science research organizations have been opened to the soft sciences, a group of natural scientists and engineering specialists have shifted to soft science or do soft science research as well.

There is more and more vigor in research into the study of science, for which some research organizations have been established; as for example the Institutes for the Study of Science in Shanghai, Tianjin, and Beijing.

There is a clear trend in the higher institutions for the emergence of cross fertilization between science and engineering courses and the social sciences.

The advising industry is just now flourishing in this country, especially technical consulting and demonstrations for large projects, which has also generated great social and economic results.

In view of foreign soft science research in the mid and later 1970's, Chinese soft science during the Sixth 5-Year Plan began to be applied in several areas, the obvious characteristic of which has been the necessarily close connection between soft science research and economic construction, and from which research results have been seen.

Soft science research serves overall decision making by the state, as for example the compilation of the "Table of National Investment and Output Values" that included 24 economic departments and the building of the national macroscopic economic model.

Large scale technology policy research and demonstrations have begun, and major soft science projects like "China in the Year 2000" have been completed.

In the forecasting of science and technology development, the requirements for closely integrating the needs of actual decision making and management have begun a group of large scale research projects. As for example study of the state energy resources model; forecasting the development of the unification of machinery with electronics; forecasting research into the future for Chinese microelectronics technology development; forecasting of Chinese information systems development; studies of science and technology target

systems; surveys and forecasting of Chinese industrial technology levels and models; comprehensive analysis of large city transportation and shipping; studies of urban ecological systems; research into China's electric power planning; agricultural systems engineering, and studies into the forecasting of greater agricultural development.

Integration of local characteristics to develop soft science research, as for example the research into development strategies for the nation's capital; studies of Shanghai's economic development strategies, and studies of energy resource divisions in Shanxi Province.

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NATIONAL DEVELOPMENTS

SYSTEMS ENGINEERING RESULTS IN DALIAN AREA DESCRIBED

Beijing RENMIN RIBAO in Chinese 8 Aug 86 p 3

[Text] A soft science research contingent at the Systems Engineering Laboratory at the Dalian Engineering Academy, led by Professor Wang Zhongtuo [3769 5883 2094] and made up of the young, middle-aged, and senior, has completed more than 20 research and development projects over the last 9 years, about half of which have been adopted for use or have been applied in actual production.

In the aspect of research into network planning technology and dissemination of applications, the computer software system that they have developed, having a decision key routing method, composite network method, and network planning management, has been applied domestically at several enterprises with excellent results. With figures from only some 10 factories, increased output value has been 60 million yuan, with profits and tax revenue of more than 13 million yuan. The network planning technology has been used in the manufacturing process for the radio-cassette 2L141 pattern die made by the Shanghai Radio Factory No 2, and the period for the manufacture of the entire set of molds was reduced from one-half year to 3 months, from which was realized an increase in output value of 1.154 million yuan, with a profit of 214,000 yuan. This achievement won a first prize from the Shanghai Municipal Economics Commission.

In the area of energy resource systems engineering, they researched and developed for the department of electric power development planning models and software for development of a thermoelectric power source. After analysis and application of the second loop engineering from Liujiaxia to Guangzhong, it was shown that in comparison with traditional manual planning the lesser amount of water used at the hydroelectric plant converted to 400 million kwh of electrical energy; in an application for another project, annual expenses of 9.248 million yuan were saved. At the evaluation conference by relevant departments, this was considered to be the first model and software to reach the level of actual use in this country.

In the area of agricultural systems engineering, the research that they did on agricultural and industrial structures on behalf of Wafangdian, affiliated with the city of Dalian, and the analysis of the optimal reasonable distribution of fruit trees and food crops in this apple base area, produced

results that have been adopted by the Wafangdian municipal party commission and the city government. Based on the planning of Liaoning Province regarding establishment of agricultural modern model counties, they are also currently doing research on establishment of a county level comprehensive economic information and decision making system on the basis of a computerized natural resources data bank and planning system that is centered on Kalaqinzuoyi Mongol Nationality Autonomous County.

Regarding analysis of water resource systems, they have done certain plans for Angang concerning rational use of water. They did quantitative analyses of the relations between amounts of water used in Angang and underground water locations, from which they could provide data for reference in decisionmaking.

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CSO: 4008/2126

NATIONAL DEVELOPMENTS

YOUNG RESEARCHERS AWARDED FOR S&T ACHIEVEMENTS

OW301630 Beijing XINHUA in English 1531 GMT 30 Aug 86

[Text] Beijing, 30 Aug (XINHUA)--Eleven young scientific researchers whose work has been judged as meeting internationally advanced standards will be awarded prizes, it was announced here today.

Under the auspices of the Beijing Science and Technology Association, the prizes are the first to be bestowed on people under 35 years old who have made scientific achievements. The prizes will be awarded every two years, according to an association official.

Selected from 122 outstanding young scientific researchers, the winners will receive 1,000 yuan (about U.S.$270) each, equal to an ordinary worker's annual wage.

The youngest, 23-year-old Huang Yidong, gained a master's degree at the Beifang Jiaotong University in Beijing two years ago. Last June three of his papers received special attention from the two committees of the International Photographic Surveying and Remote-Sensing Society, and were included in a collection of conference papers and the international photographic surveying files.

Another prize-winner, Feng Changgen, won his PHD from a British university and has issued an average of almost eight papers a year since he returned home in 1982. He has reported his scientific findings to seven influential international academic conferences.

An official of the Beijing Science and Technology Association told XINHUA that these young researchers have selected scientific subjects which combine China's actual needs with international scientific development, and positively put the theory into practice.

He said that a prize-giving ceremony will be held 14 September in Beijing.

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CSO: 4010/2002

NATIONAL DEVELOPMENTS

NATURAL SCIENCE FOUNDATION TO AWARD RESEARCH GRANTS

OW181547 Beijing XINHUA in English 1150 GMT 18 Oct 86

[Text] Beijing, 18 Oct (XINHUA)--China's State Natural Science Foundation Committee which supports basic and applied research will publish results from a number of research projects, according to today's overseas edition of the PEOPLE'S DAILY.

Since it was established this February, the foundation committee, which is an academic body made of scientists and experts funded mainly by the state, has received about 12,000 applications for research projects.

To fund all the projects the committee could spend about one billion yuan (U.S.$270 million), the paper said. The committee has organized a panel of scientists to assess the applications before granting financial support.

The aim of the foundation is to promote scientific research and encourage competition. All scientific workers in China are eligible to apply for grants from the foundation. The foundation committee will also set up a special fund to discover and train more young scientists.

In addition, it will conduct academic exchanges with counterparts in other countries through joint research projects.

The committee's major tasks include developing guidelines for basic and applied research, organizing scientific grant review panels, providing advice on basic and applied research policy, and expanding cooperation with foundations and academic organizations in other countries, according to a State Council circular.

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CSO: 4010/2002

NATIONAL DEVELOPMENTS

BRIEFS

INCREASED EXPORT OF ELECTRONIC PRODUCTS--Beijing, 7 Sep (XINHUA)--China almost doubled its export of electronic products to the European, American and Southeast Asian countries in the first half of this year, according to the CHINA ADVERTISER today. Deals concluded in the first six months were worth more than U.S.$223.3 million, up 90.97 percent from the same period last year. In recent years, marked improvement has been shown in the quality of television sets, radio cassette recorders, radio sets, electronic organs and satellite ground stations sold to these areas. [Text] [Beijing XINHUA in English 0610 GMT 7 Sep 86 OW] /9738

HI-TECH PRECISION INSTRUMENT--Beijing, 14 Sep (XINHUA)--China has succeeded in developing a kind of hi-tech precision instrument--program controlled frequency scanning signal generator--which will be put into mass production soon. The overseas edition of the PEOPLE'S DAILY quoted hi-tech experts as saying that the success has filled a gap in China's microwave automatic measuring and testing technology. The technical performance of the instrument has reached the 1980's level of similar products in the world and the price is half as much, the report says. China used to depend on imports for the supply of such instruments and now orders have kept coming in from all parts of the country for the newly developed product. It is estimated that it will save nearly U.S.$100 million of foreign exchange. Developed by the Tai'an Qinghua Instruments and Meters Plant in Gansu Province, the new product is widely applied in testing, developing and maintaining satellite ground stations, microwave relay stations, radars and laser equipment. [Text] [Beijing XINHUA in English 0705 GMT 14 Sep 86 OW] /9738

SHANGHAI RADIATION TECHNIQUES CENTER--Shanghai, 19 Sep (XINHUA)--China's first center for the popularization of the application of radiation techniques to production was approved by the authoritative Chinese Academy of Sciences today after four-month trial operation, in China's biggest industrial city of Shanghai. The center, with a loading capacity of 500,000 curies covers an area of 4,000 sq meters. It contains facilities for radiation, a loading and unloading yard, a control room and a laboratory, according to an official of the center. The radiation center, easy to install and economical, is particularly suitable for developing countries. It will provide complete sets of equipment and train personnel for other countries after it starts operation soon. The radiation techniques involved include those to keep

foodstuffs fresh and disinfect medical apparatus. Tests show that radiation reduces the rate of decay of apples by 20 percent; it only costs the equivalent of two U.S. cents to radiate one kg of apples. Chinese scientists began to study the peaceful uses of nuclear energy in the 1950s. Radiation techniques have since been used to develop 150 superior strains of crops and have yielded an extra 2,500 tons of grain. [Text] [Beijing XINHUA in English 0812 GMT 19 Sep 86 OW] /9738

COMPUTER SIMPLIFIES CHINESE CHARACTERS--Beijing, 2 Oct (XINHUA)--An engineer in China's Henan Province has developed a computer on which an operator can input even the most complicated Chinese characters by striking the keyboard just five times. The computer, designed by deputy chief engineer Wang Yongmin of the Henan Provincial Computer Center, can be used in news editing, publication and research, a spokesman for the center said today. The five main keys represent the five strokes used to make the thousands of characters that constitute Chinese writing. Some characters require only one stroke. Others use the same strokes in different places, requiring up to 15 or more movements. What makes this computer unique is that it can recognize even the most complicated characters after five strikes of the keyboard. "The operator can put a character with more than five strokes into the computer's memory just by typing the keys for its first four and last strokes," the spokesman said. "Anyone able to write Chinese characters can learn to type on the machine in ten minutes," he said adding that during one of his inspection tours of Henan in recent years, party leader Hu Yaobang input five Chinese characters into the machine. [Text] [Beijing XINHUA in English 1234 GMT 2 Oct 86 OW] /9738

CHINA'S FIRST OCEAN LABORATORY--Beijing, 3 Oct (XINHUA)--Work on China's first ocean laboratory simulating a marine environment has been finished in Qingdao City, in east China's Shandong Province, SCIENCE NEWS reports. This kind of laboratory used for marine studies previously existed only in Japan and the United States, the paper said. China started to build the laboratory at the end of last year with materials imported from Japan. The laboratory, 5 meters high and 16 meters in diameter, can endure high pressure and better simulate the actual marine environment than ordinary aquariums. Within its 300 cubic meters of water, rare fish and lobsters can be bred, the paper said. Visitors may see the "artificial ocean" through eight pieces of plexiglasses, each the size of a motion-picture screen. [Text] [Beijing XINHUA in English 1615 GMT 3 Oct 86 OW] /9738

JIANGSU HYDROCRACKING PLANT--Nanjing, 4 Oct (XINHUA)--An imported plant able to turn heavy oil into aviation fuel and fossil oil went into operation today at the Nanjing Oil Refinery, east China's Jiangsu Province. The hydrocracking installation will produce about 400,000 tons of quality aviation fuel and Diesel oil annually, yielding profits of 50 million yuan, an official of the plant said. [Text] [Beijing XINHUA in English 1602 GMT 4 Oct 86 OW] /9738

SHANGHAI FLOPPY DISK PRODUCTION--Shanghai, 29 Aug (XINHUA)--The quality of the first batch of floppy disks produced by China's largest production line in Shanghai is up to the ANSI (American National Standards Institute) standard and the world level, a local official said today. Imported from an American company, the line is able to produce annually 12 million sets of the disk; about 80 percent of them will be exported to Europe, the United States and Hong Kong. The line went into operation Thursday at the Huxing Electronics Company, a joint venture between Shanghai and Hong Kong. [Text] [Beijing XINHUA in English 1418 GMT 29 Aug 86 OW] /9738

NEW 16-BIT MICROCHIP--Shanghai, 13 Aug (XINHUA)--An integrated circuit used for the latest design of a 16-bit microcomputer passed certificate tests in this leading industrial city of China today. About the size of a soya bean, the circuit includes 17,500 mos transistors, nearly 40,000 lead-wire holes and a memory-control system. Developed by the Shanghai Metallurgical Research Institute, the CPU circuit can be used in automatic control and management computer systems and in space navigation. China expects to reduce imports of integrated circuits in the near future when the Lishan Microelectronics Industrial Company attached to the Ministry of Astronautics begins production. [Text] [Beijing XINHUA in English 1502 GMT 13 Aug 86 OW] /9738

HEBEI'S LARGEST ANTIBIOTICS PLANT--Shijiazhuang, 13 Sep (XINHUA)--The renovation of China's biggest antibiotic plant has passed state acceptance tests and will soon begin mass production to meet increasing domestic and foreign demand. The north China pharmaceutical factory, in Shijiazhuang, capital of Hebei Province, will turn out 458 tons of sodium penicillin a year, about one-sixth of China's present output. The renovation project began in 1981 and cost 70 million yuan (about 18.9 million U.S. dollars). It includes seven single projects for the fermentation and refinement of penicillin. China's largest antibiotics producer exports products to 25 countries and regions in addition to supplying domestic needs. Several of its main products, including sodium penicillin, glucose, have won state gold and silver medals for its high quality. [Text] [Beijing XINHUA in English 0202 GMT 13 Aug 86 OW] /9738

DOMESTIC TV PARTS--Beijing, 26 Aug (XINHUA)--Chinese television manufacturers have been reducing imported parts in their color sets thanks to progress within China's electronics industry, the overseas edition of the PEOPLE'S DAILY reported today. The communist party paper said most of the parts in domestic color television sets, video and tape recorders and computers are locally made and some are being exported. "This progress is a result of opening China to the outside world," the paper said. "We have been able to replace many old-fashioned machines with imported equipment that has enabled us to produce goods meeting international market standards." In addition, it said, better management of many of the country's factories has guaranteed a stable supply of reliable electronic components. [Text] [Beijing XINHUA in English 0535 GMT 26 Aug 86 OW] /9738

RESEARCH PATENTED ABROAD--Shanghai, 30 Sep (XINHUA)--Forty-nine universities in Shanghai have sold or are in the process of patenting research findings abroad, city education officials said today. Many of the 160 projects that sparked interest overseas were developed with foreign cooperation. These have included genetic research at Fudan University supported by a company manufacturing interferon in the United States, and development of a switching device at the Shanghai Railway College assisted by a Japanese company. Other joint research has involved computers and laser photocomposition. Working on their own, scholars in Shanghai have developed research to sell abroad. For example, the Huadong Chemical College has applied for patents in Japan and the United States for its new method of extracting citric acid from fermenting liquids. Some of the findings will be displayed in Guangzhou at the China Trade Fair, which begins in October. [Text] [Beijing XINHUA in English 0739 GMT 30 Sep 86 OW] /9738

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PHYSICAL SCIENCES

FORECASTING TYPHOON FORMATION, DEVELOPMENT IN SOUTH CHINA SEA

Beijing NANHAI HAIYANG KEXUE JIKAN [NANHAI STUDIA MARINA SINICA] in Chinese
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[Article by Huang Zhixing [7806 1807 5281], Liu Jialing [0491 0857 3781], and Cheng Zhiqiang [4453 1807 1730] of the Chinese Academy of Sciences, South China Sea Institute of Oceanography, paper received 24 Jan 81; title footnoted as follows: This paper was checked by Professor Chen Shixun [7115 0013 6064] of the Zhongshan University Meteorology Department; Comrade Fan Shihung [4636 0013 3163] et al. assisted in arranging the data; for this we are grateful.]

[Text] The formation, development and movement of typhoons is an extremely complex problem. Tropical low pressure systems may or may not signal the development of a typhoon and its direction of movement, depending upon the interaction between the flow conditions at the periphery and the conditions at the interior of the low pressure system, and this is associated with the comprehensive effects of sea-air exchange, leading air currents, southwest monsoons, and cold air among other things.

To the present, both within and outside of China, there has been little study of forecasting methods for the formation and development of typhoons. In particular, forecasting methods for typhoon formation and development in the South China Sea are even more scarce. For the most part, the studies concentrate on analyses of the conditions of typhoon formation and development. Moreover, they are often limited to sample analyses.

The Hong Kong Meteorological Observatory's S.Y.W. Tse adopted the mathematical statistics method of forecasting. The crux of this method is to calculate the value of D in $D = \nabla_h^2(\psi_{250} - \psi_{750}) - \nabla_h^2(\phi_{250} - \phi_{750})$, on the basis of a D value of the 6th degree, to differentiate between a low pressure system that will or will not develop into a typhoon, and the intensity of the development. But, this work does not include results from this method.

The Guangdong Meteorological Observatory and Zhongshan University jointly put forward a forecasting method which classifies the situation of the upper atmosphere 1 or 2 days prior to the formation of a typhoon to find dissimilar seasonal forecasting indications.

This work selects, among other things, the sea-air exchange intensity of sensible heat, the sea surface temperature, atmospheric stratification stability, the location of secondary high pressure systems, and the location (latitude) of cold air and low pressure systems (or typhoons) as forecasting factors, divides them into 3, 4 or 5 groups, and determines the weighted contribution of each group as to the formation and development of typhoons, whether or not they will land, and where they will land. Taking the factors two by two, we select the best combination of mutually effective average weights, utilize weighted addition, and, through step-by-step resolution, achieve forecasting results.

We carried out statistical analysis on 63 low pressure systems in the South China Sea (including low pressure systems moving into the South China Sea from the Pacific Ocean) from June to October in the years 1970 to 1979, as to whether or not they developed into typhoons; on 112 typhoons and low pressure systems (including typhoon moving into the South China Sea from the Pacific Ocean) as to whether or not they landed, either the location of landing or the direction of movement of the typhoons (low pressure systems) that did not land. Additionally, we tested and reported on 9 typhoons and low pressure systems from June to October in 1969 and 8 typhoons and low pressure systems from June to August in 1980 and the results were good.

I. Data and Forecasting Factors and Technological Specifications

1. Source of the Data

All the data used in this work was taken from 1970 to 1979 and represent ground level as well as 850, 700, and 500 millibars on the weather map, the "Typhoon Almanac," and the "Typhoon Route Map" of the Guangdong meteorological office.

2. The Reporting Line, the Forecasting Targets, and the Reporting Dates

The reporting line of typhoons (or low pressure systems) entering the South China Sea from the Pacific Ocean, as shown in the figure below, indicates the reporting line of tropical lows in the Pacific and formation of tropical lows in the South China Sea, and serves as a forecasting target for the formation and development of typhoons in the South China Sea. The reporting line of Pacific Ocean typhoons (or low pressure systems) and South China Sea typhoons (or low pressure systems) serves as a forecasting target for whether or not they will land, where they will land, and their direction of movement. The reporting date for Pacific Ocean typhoons (low pressure systems) is the date of entering the reporting line; the reporting date for South China Sea typhoons (low pressure systems) is the day of formation of the low pressure system.

3. Calculation of Factor Values

The key factors (Footnote 1) (Examples of the key meteorological factors at 0800 hours are the air temperature, sea surface temperature, wind, dewpoint, pressure change, location of secondary highs (latitude), apparent

position-temperature relationship, etc.) on the day of the formation of the low pressure systems in the South China Sea or the day the center of Pacific Ocean typhoons (low pressure systems) enter the reporting line and the key factors of the previous day at 0800 hours are averaged.

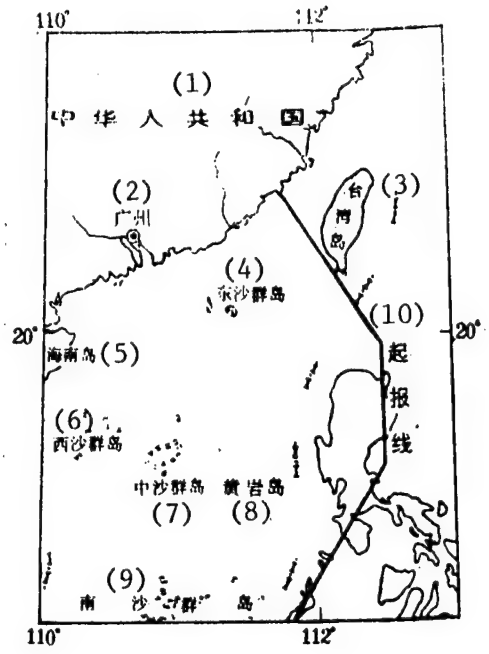

Figure 1. Map of the reporting line for Pacific Ocean typhoons and low pressure systems entering the South China Sea

Key:

1. People's Republic of China
2. Guangzhou
3. Taiwan
4. Dongsha Archipelago
5. Hainan Island
6. Xisha Archipelago
7. Zhongsha Archipelago
8. Huangyan Island
9. Nansha Archipelago
10. Reporting line

4. Selection of Forecasting Factors

The formation and movement of typhoons depend on the interaction of the interior conditions and the conditions on the periphery and are a result of the comprehensive effects of each forecasting factor.

Much research indicates that the effects of the ocean are extremely important to the formation and development of typhoons. High temperature sea surface can provide an unbroken supply of heat and water vapor to the lower atmospheric layers, influencing the air temperature and water vapor distribution of the lower layers due to the heat transport from the ocean to the atmosphere, and providing all the heat needed for a warm center in the course of forming a typhoon from a developing low pressure system. Therefore, the transport of sensible heat is the important energy source in the formation and development of typhoons.

Air convection from geopotential instability created by dissimilar thermal conditions is important, particularly with the appropriate incursion of cold air into the South China Sea, increasing the air pressure over the ocean, releasing baroclinic energy, raising the warm, moist air, and accelerating the developing convection. Other prevailing southwesterly air currents are strengthened in the lower layers of the atmosphere, accelerating the development of turbulence over the baroclinic line. Therefore, the latter has an equally stimulating effect on the formation and development of typhoons.

Secondary tropical high pressure systems in different locations form different flow environments, particularly when the secondary high pressure system and the typhoon (low pressure system) are located in a certain position. The easterly air current at the southern edge of the high pressure system has an effect on the formation and development of the typhoon, and can also determine the movement of the typhoon. But, when the typhoon or low pressure system is located in a different position (latitude and longitude), then the effects of the leading air current and other physical forces are not the same and have a close relationship with the movement of the typhoon.

Based on cyclone discovery concepts, typhoons move in the direction of greatest negative pressure change. Therefore, the pressure change of certain sites is one of the important signs of the development and movement of a typhoon.

According to theory, using the characteristic weather features on the following table gives clear meteorological concepts and, also, forecasting targets have more clearly causative forecasting factors:

X_1: The exchange intensity of sensible heat in the South China Sea, $Q = (T_W - T)V$, showing the sensible heat transfer from the ocean to the atmosphere. In the equation, T_W, T and V are the sea surface temperature at Xisha, the land surface temperature, and the wind velocity, respectively.

X_2: $\frac{1}{4} \sum_{\text{land}}^{500 \text{ millibars}} (T - T_d)$ taking the temperature and average dewpoint values at the four levels (Xisha surface, 850, 700, and 500 millibars) and indicates the water vapor and temperature conditions of convection in the middle and lower layers.

X_3: The change in pressure over 24 hours in Guangzhou (Δp_{24}) to reflect the cold air activity.

X_4: $\Delta\theta_{sc} = \theta_{sc850} - \theta_{sc500}$ where θ_{sc850} and θ_{sc500} are the apparent position-temperature relationships of the Xisha site at 850 and 500 millibars, respectively, representing the thermal conditions of the two pressure levels.

X_5: The Xisha sea temperature, T_W, approximates the sea surface temperature of the South China Sea.

X_6: The latitude of tropical low pressure system formation in the South China Sea (or western Pacific low pressure systems and typhoons entering the reporting line).

X_7, X_8: Distinguish the line of secondary highs (latitude) and their westernmost point (longitude). (When the 588 line breaks into 2 loops, take the westernmost loop.)

X_9: $\frac{1}{3}(H^{500}_{Xisha} + H^{500}_{Fuzhou} + H^{500}_{Manila})$, where at the average altitude of 500 millibars at the 3 sites of Xisha, Fuzhou and Manila the intensity of the secondary high is indicated.

X_{10}: The wind direction at 700 millibars over Huzhiming city to indicate southwest monsoon activity.

X_{11}: $(T' - T)_{500}$ is the difference between the air temperature of the lower layers of Xisha from 850 to 500 millibars (T') and the surrounding temperature (T).

X_{12}: The 24 hour land surface pressure change at Xisha (Δp_{24}).

C: A correction factor. When there is a lack of ocean data, there are a few factors which allow use of Xisha data as representative; therefore, it is a measurement at a distance from Xisha which indicates typhoons (low pressure systems).

II. Steps of Weighted Addition

1. Forecasting factors based on the values from different forecasting targets are placed in a certain number of groups, the apparent parameter, F_{xij}, is determined from the calculations of forecasting targets in each group (where i is the sequence number of the factor, and j is the group indicator): the size of F_{xij} sets the weight of the forecasting target group contribution, A_{xij} (satisfying the condition F_{xij}/A_{xij} or $A_{xij}/F_{xij} \geq 0.5$).

2. Taking the factors two by two, select the optimum combination of mutually effective average weights, A_k:

$$A_k = \tfrac{1}{2}(Ax_{ij} + Ax_{i'j})$$

where x_i and $x_{i'}$ are a target factor combination and k is the combination sequence number.

3. Arrange a statistical table $S = \sum_{1}^{n} A_K + C$; n is based on the number of factor combinations of different forecasting targets taken two at a time, and C is the correction factor for each forecasting target.

4. Determine the critical value, y.

III. Predicting Whether Tropical Low Pressure Systems Will Develop Into Typhoons

1. Select the factors X_1, X_2, X_3, X_4, X_5, X_7, X_8, X_{10}, X_{11}, and X_{12}; comply with measure (1), (2) and enter into Table 1 (a), (b).....(f).

2. Calculate $S = \sum_{1}^{n} A_K + C$ and enter the result into Table 2.

3. Determine the critical value of S, y = 2.7. If y > 2.7, then the low pressure system will develop into a typhoon; if not, then the typhoon will not develop. Historically, the accuracy has been 63/63 = 100 percent.

From 1970 to 1979 during the months of June to October, 63 tropical low pressure systems have formed in the South China Sea (including those moving in from the Pacific). Of these, 37 have developed into typhoons.

Table 1(a). Effect of Factors X_1 and X_2 on the Average Weight A_1

A_1 Factor X_1 / X_2		Group dist.	$X_1<0.5$	$0.5\leqslant X_1<3.5$	$3.5\leqslant X_1$
		wgt.	0.300	0.750	0.850
Group distribution	weight				
$4.5\leqslant X_2$	0.300		0.300	0.525	0.575
$3.0<X_2<4.5$	0.450		0.375	0.600	0.650
$X_2\leqslant 3.0$	0.800		0.550	0.775	0.825

Table 1(b). Effect of Factors X_4 and X_{11} on the Average Weight A_2

A_2 X_4 / X_{11}		Group dist.	$X_4\leqslant 1$	$1<X_4<6$	$6\leqslant X_4$
		wgt.	0.400	0.500	0.600
Group distribution	weight				
$X_{11}<-0.5$	0.100		0.250	0.300	0.350
$-0.5\leqslant X_{11}\leqslant 0.5$	0.550		0.475	0.525	0.575
$0.5<X_{11}$	0.800		0.600	0.625	0.700

Table 1(c). Effect of Factors X_5 and X_{12} on the Average Weight A_3

A_3 / X_{12}	X_5	Group dist.	$X_5<28.5$	$28.5\leqslant X_5\leqslant 29.0$	$29.0<X_5$
		wgt.	0.300	0.500	0.750
Group distribution	weight				
$0.5<X_{12}$	0.300		0.300	0.400	0.525
$-0.5\leqslant x_{12}\leqslant 0.5$	0.450		0.375	0.475	0.600
$X_{12}<-0.5$	0.850		0.575	0.675	0.800

Table 1(d). Effect of Factors X_7 and X_8 on the Average Weight A_4

A_4 / X_8	X_7	Group dist.	$X_7<22$	$22\leqslant X_7\leqslant 28$	$28<X_7$
		wgt.	0.500	0.700	0.200
Group distribution	weight				
$120<X_8$	0.200		0.350	0.450	0.200
$100\leqslant X_8\leqslant 120$	0.500		0.500	0.600	0.350
$X_8<100$	0.700		0.600	0.700	0.450

Table 1(e). Effect of Factors X_3 and X_{10} on the Average Weight A_5

A_5 / X_{10}	X_3	Group dist.	$X_3\leqslant 0$	$0<X_3\leqslant 1.5$	$1.5<X_3$
		wgt.	0.450	0.600	0.300
Group distribution	weight				
NNW —E— SSE	0.300		0.375	0.450	0.300
S——SW	0.950		0.700	0.775	0.625
WSW —W— NW	0.600		0.525	0.600	0.450

Table 1(f). Correction Factor, C

Distance (longitudinal) from Xisha	<3.0	3.0—6.0	6.0<
Correction factor	0.05	0.200	0.320

Table 2. Statistical Chart of Whether Tropical Low Pressure Systems Develop Into Typhoons

Sequence No.	Serial No.	Intensity	X_1/X_2	A_1	X_4/X_{11}	A_2	X_9/X_{12}	A_3	X_7/X_8	A_4	X_3/X_{10}	A_5	*/C	S
1	70⑧	T	−1.9/4.4	0.375	4.5/0.9	0.650	29.2/−0.6	0.800	17.0/105.5	0.500	−0.1/NW	0.525	3.9/0.20	3.050
2	70④	L	3.0/3.8	0.600	3.5/0.3	0.525	28.5/0.9	0.400	20.3/128.5	0.350	−0.2/WNW	0.525	1.0/0.05	2.450
3	70⑤	L	10.0/3.3	0.650	5.5/0.5	0.525	29.3/1.2	0.525	21.6/104.5	0.500	1.9/WSW	0.450	2.3/0.05	2.700
4	70㉑	L	−1.8/4.9	0.300	0.5/−1.3	0.250	29.4/−0.8	0.800	28.7/103	0.350	−0.1/WSW	0.525	4.2/0.20	2.425
5	70㉙	L	3.3/2.5	0.775	4.5/1.6	0.650	28.2/0.7	0.300	32.4/121	0.200	1.0/W	0.600	1.0/0.05	2.575
6	70㉞	L	1.3/5.3	0.525	5.5/0.1	0.525	28.2/−0.1	0.375	28.5/100.5	0.350	−1.3/NNE	0.375	5.5/0.20	2.350
7	7012	T	0.5/3.8	0.600	2.0/−0.4	0.525	27.4/0.9	0.300	23.2/98	0.700	0.3/SE	0.450	5.7/0.20	2.775
8	70㉟	L	−6.2/4.8	0.300	2.5/−1.4	0.300	27.3/1.5	0.300	21.8/109	0.500	2.7/W	0.450	9.7/0.32	2.170
9	70㉜	L	−0.4/5.1	0.300	3.5/−1.4	0.300	27.9/−1.3	0.575	28.2/109	0.350	−1.4/N	0.375	9.7/0.32	2.220
10	71⑪	L	−1.2/4.4	0.375	2.5/1.3	0.650	27.5/0.0	0.375	19.3/108	0.500	−1.7/ESE	0.375	9.7/0.32	2.595
11	71⑬	L	−4.3/5.3	0.300	3.5/0.3	0.525	28.0/1.1	0.300	23.5/109.5	0.600	2.2/NW	0.450	5.4/0.20	2.375
12	71㉔	L	−5.1/4.1	0.375	7.5/1.4	0.700	28.0/−1.0	0.575	32.2/127	0.200	−1.5/W	0.525	10.3/0.32	2.695
13	7112	T	−1.4/5.6	0.300	8.5/0.8	0.700	27.5/1.2	0.300	27.7/117	0.600	1.6/SW	0.625	7.1/0.32	2.825
14	71㉘	L	0.3/11.3	0.300	9.0/−1.6	0.350	29.2/−0.5	0.600	34.9/111	0.350	−0.7/SW	0.700	6.2/0.32	2.620
15	71㉚	L	0.2/4.8	0.300	−2.0/−1.4	0.250	28.4/1.1	0.300	24.1/126	0.450	1.2/SSW	0.775	3.6/0.20	2.275
16	72⑥	T	0.4/4.4	0.375	6.5/0.9	0.700	28.7/−0.8	0.675	21.9/105	0.500	1.1/NW	0.600	4.2/0.20	3.050
17	72⑦	L	−3.9/3.3	0.375	7.0/1.7	0.700	28.4/0.8	0.300	17.6/123	0.350	1.6/SW	0.625	9.7/0.32	2.670
18	72⑪	L	0.2/4.9	0.300	2.0/−1.3	0.300	28.8/−0.2	0.475	26.3/112.5	0.600	0.0/W	0.525	2.5/0.05	2.250
19	7204	T	−0.7/5.5	0.300	6.5/−0.01	0.575	28.8/−0.6	0.675	28.6/106	0.350	0.3/W	0.600	9.7/0.32	2.820
20	7210	T	1.6/3.9	0.600	4.0/0.8	0.650	29.0/0.1	0.475	26.2/105	0.600	0.3/WNW	0.600	10.0/0.32	3.245
21	7211	T	−0.9/4.2	0.375	4.0/0.6	0.650	27.7/1.3	0.300	28.6/107	0.350	1.5/SW	0.775	8.5/0.32	2.770
22	7212	T	0.4/4.5	0.300	5.0/−0.5	0.525	27.2/−0.4	0.375	22.7/103.5	0.600	−1.0/SSW	0.700	10.0/0.32	2.820
23	7216	T	−0.1/3.4	0.375	8.0/2.1	0.700	28.5/0.5	0.475	23.6/88	0.700	1.4/ENE	0.450	5.0/0.20	2.900
24	7301	T	3.1/7.3	0.525	4.5/−1.5	0.300	30.1/−0.4	0.600	25.9/110.5	0.600	1.3/E	0.450	9.7/0.32	2.795
25	7302	T	4.0/7.1	0.575	7.5/0.3	0.575	30.5/−0.8	0.800	19.2/124.5	0.350	−2.4/WSW	0.525	6.2/0.32	3.145
26	7304	T	2.9/4.0	0.600	3.0/0.2	0.525	29.2/0.5	0.600	26.2/116	0.600	0.2/WSW	0.600	4.2/0.20	3.125
27	7307	T	2.5/2.8	0.775	2.5/0.8	0.650	29.8/0.3	0.600	33.1/105	0.350	1.0/ESE	0.450	10.0/0.32	3.145
28	7311	T	3.1/3.3	0.600	4.3/1.7	0.650	29.2/−1.1	0.800	33.7/91	0.450	0.0/W	0.525	9.7/0.32	3.345
29	7312	T	8.2/2.4	0.825	−1.0/0.0	0.475	29.1/0.8	0.525	31.3/97	0.450	0.0/SW	0.700	1.0/0.05	3.025
30	73⑱	L	0.0/4.6	0.300	5.5/−0.2	0.525	29.4/0.5	0.600	21.8/100	0.500	1.4/SE	0.450	3.8/0.20	2.575
31	7316	T	2.1/2.8	0.775	8.0/3.3	0.700	28.7/−0.5	0.475	28.2/89	0.450	0.4/E	0.450	5.0/0.20	3.050
32	74⑤	T	8.8/5.4	0.575	4.0/0.4	0.525	29.3/−1.2	0.800	21.3/120.5	0.350	1.8/WNW	0.450	1.5/0.05	2.750

[Continued on following page]

Sequence No.	Serial No.	Intensity	X_1/X_2	A_1	X_4/X_{11}	A_2	X_5/X_{12}	A_3	X_7/X_8	A_4	X_9/X_{10}	A_5	**/C	S
33	7412	T	0.6/5.1	0.525	−0.5/−2.0	0.250	29.5/−1.8	0.800	30.5/116	0.350	−1.8/WSW	0.525	6.6/0.32	2.770
34	74⑳	T	27.8/4.0	0.650	5.5/0.4	0.525	29.5/−1.5	0.800	34.9/131	0.200	−0.4/NW	0.525	4.0/0.20	2.900
35	7417	T	2.5/3.0	0.775	0.5/−0.2	0.475	28.7/1.1	0.400	18.5/138	0.350	0.6/SW	0.775	5.9/0.20	2.975
36	7419	T	−0.9/5.0	0.300	4.5/0.3	0.525	28.0/0.2	0.375	26.7/140	0.450	0.2/SSW	0.775	7.1/0.32	2.745
37	75⑤	L	0.7/4.5	0.525	1.5/−0.7	0.300	29.7/−0.2	0.600	21.3/126	0.350	1.4/WNW	0.600	4.5/0.20	2.575
38	7506	T	−2.5/3.9	0.375	10.0/2.4	0.700	29.0/−1.5	0.675	28.2/112	0.350	0.6/W	0.600	3.9/0.20	2.900
39	75⑬	L	−7.2/6.2	0.300	7.5/−0.4	0.575	28.4/−0.4	0.375	26.6/109	0.600	−1.1/WNW	0.525	9.2/0.32	2.695
40	75⑭	T	3.3/3.1	0.600	3.5/1.6	0.650	28.0/1.4	0.300	37.2/91	0.450	1.4/SW	0.775	1.5/0.05	2.825
41	75⑰	L	−0.3/6.6	0.300	7.0/−0.2	0.575	27.9/−1.3	0.575	33.6/110	0.350	−1.0/WNW	0.525	5.8/0.20	2.525
42	7513	T	1.4/6.1	0.525	3.5/−1.5	0.300	28.9/−0.7	0.675	26.2/96	0.700	0.1/SW	0.775	7.8/0.32	3.295
43	7515	T	3.9/3.1	0.650	−0.5/−0.4	0.475	27.4/−1.9	0.575	21.6/125	0.350	−1.9/W	0.525	9.7/0.32	2.895
44	76⑧	L	−0.5/4.5	0.300	3.0/−4.0	0.300	28.9/0.3	0.475	22.5/117	0.600	0.8/WSW	0.600	1.0/0.05	2.325
45	7610	T	1.4/10.8	0.525	7.0/−3.0	0.350	28.9/−0.7	0.675	26.0/116	0.600	0.1/W	0.600	4.9/0.20	2.950
46	7614	T	−1.1/3.8	0.375	1.5/0.0	0.525	28.4/−0.8	0.575	29.6/106	0.350	−0.7/SW	0.700	4.5/0.20	2.725
47	7619	T	2.5/5.9	0.525	−2.5/−3.9	0.250	28.7/−1.1	0.675	24.8/92	0.700	−0.8/W	0.525	2.0/0.05	2.725
48	7701	T	−2.5/7.6	0.300	7.5/0.9	0.700	29.4/−1.3	0.800	21.6/107	0.500	1.1/SE	0.450	9.2/0.32	3.070
49	7702	T	0.3/5.3	0.300	4.0/−1.1	0.300	29.7/−1.9	0.800	27.1/113	0.600	−1.0/WNW	0.525	3.0/0.20	2.725
50	7709	T	−0.4/3.5	0.375	2.5/0.3	0.525	28.8/−2.0	0.675	25.3/108	0.600	−1.3/W	0.525	9.7/0.32	3.020
51	78⑤	L	3.0/3.5	0.600	−0.5/−0.6	0.250	29.0/−1.3	0.675	29.7/113	0.350	0.6/WNW	0.600	5.1/0.20	2.675
52	7804	T	−2.2/6.8	0.300	8.5/−0.2	0.575	28.8/3.1	0.400	25.8/108	0.600	−4.7/SSW	0.700	9.7/0.32	2.895
53	7807	T	2.0/3.0	0.775	0.5/0.1	0.475	29.5/−1.4	0.800	34.2/110	0.350	−0.4/W	0.525	1.0/0.05	2.975
54	7809	T	22.3/2.2	0.825	−0.5/−0.5	0.475	29.3/3.9	0.525	33.7/110	0.350	−1.2/WNW	0.525	3.0/0.20	2.900
55	78⑩	L	−0.2/4.5	0.300	1.0/0.0	0.475	28.6/1.2	0.400	32.8/113	0.350	−0.8/WNW	0.525	7.8/0.32	2.370
56	78⑫	L	1.3/3.7	0.600	1.0/−0.9	0.250	28.9/0.9	0.400	28.8/103	0.350	1.1/S	0.775	6.4/0.32	2.695
57	78⑮	L	0.8/4.6	0.525	1.5/−1.2	0.300	28.1/−0.8	0.575	28.2/100	0.350	−0.7/W	0.525	9.7/0.32	2.595
58	78⑱	T	0.7/2.4	0.775	−4.5/−1.5	0.250	26.5/2.3	0.300	26.4/103	0.600	−0.4/S	0.700	10.0/0.32	2.945
59	79⑦	L	2.9/5.0	0.525	4.0/−0.9	0.300	30.2/−0.3	0.600	26.6/93	0.700	−0.3/SE	0.375	4.5/0.20	2.700
60	79⑨	L	3.3/3.8	0.600	2.5/0.2	0.525	29.9/2.3	0.525	29.9/72	0.450	6.8/W	0.450	2.4/0.05	2.600
61	79⑫	T	5.9/2.3	0.825	6.5/2.5	0.700	29.8/−0.4	0.600	28.4/85	0.450	−0.2/SE	0.375	0.5/0.05	3.000
62	7918	T	3.6/6.4	0.575	1.5/−3.6	0.300	27.8/0.0	0.375	22.4/9.0	0.700	−1.3/NW	0.525	6.5/0.32	2.795
63	79⑱	L	4.2/9.8	0.575	−4.0/6.4	0.250	26.9/0.01	0.375	28.2/134	0.200	−0.8/NE	0.375	6.1/0.32	2.095

*"70 ③" indicates the 3d typhoon of 1970, "7012" indicates the 12th typhoon of 1970.

**refers to the distance from the Xisha site of typhoons (low pressure systems) entering the reporting line from the Pacific and low pressure systems forming in the South China Sea.

Key: Under "Intensity" column: T = typhoon, L = low pressure system

IV. Predicting the Direction of Movement of Typhoons and Low Pressure Systems

From 1970 to 1979, during the months of June to October, there were 112 typhoons and low pressure systems in the South China Sea (including those moving in from the Pacific); of these, 60 landed (east to Huian, Fujian; the others did not land). Of those that landed, there were 16 at Aodong (east of 114°E), and 44 at Aoxi (west of 114°E). Of the 52 that did not land, 9 moved east to 120°E, 10 dispersed at sea, and 33 moved west to Vietnam and the northern section of the bay.

1. Predicting Whether a Typhoon Will Land

The effects of the direction of motion of typhoons or low pressure systems and their positions (latitude, the leading air currents, cold air, and southwesterly air currents are closely related. Select the factors X_1, X_3, X_5, X_6, X_7, X_8, X_{10}, and X_{12} according to measures (1) and (2) and complete Table 3 (a), (b).....(e).

Table 3(a). Effect of Factors X_1 and X_5 on the Average Weight A_6

A_6 / X_5	X_1	Grp. dist wgt.	$X_1<-3.5$	$-3.5\leqslant X_1\leqslant 0$	$0<X_1<2.0$	$2.0\leqslant X_1<5.0$	$5.0\leqslant X_1$
			0.200	0.400	0.650	0.700	0.900
Group dist.	weight						
$X_5<27.0$	0.200		0.200	0.300	0.425	0.450	0.550
$27.0\leqslant X_5\leqslant 28.0$	0.350		0.275	0.375	0.500	0.525	0.625
$28.0<X_5<29.0$	0.500		0.350	0.450	0.575	0.600	0.700
$29.0\leqslant X_5\leqslant 29.5$	0.600		0.450	0.500	0.625	0.650	0.750
$29.5<X_5$	0.750		0.475	0.575	0.700	0.725	0.825

Table 3(b). Effect of Factors X_3 and X_{10} on the Average Weight A_7

A_7 / X_{10}	X_3	Grp. dist wgt.	$X_3>2.0$	$2.0\geqslant X_3\geqslant 1.0$	$1.0>X_3\geqslant -0.5$	$-0.5>X_3\geqslant -1.5$	$-1.5>X_3$
			0.300	0.400	0.500	0.600	0.650
Group dist.	weight						
NW-NNE	0.200		0.250	0.300	0.350	0.400	0.425
NE-E	0.450		0.375	0.425	0.475	0.525	0.550
ESE-S	0.400		0.350	0.400	0.450	0.500	0.525
SSW-WSW	0.600		0.450	0.500	0.550	0.600	0.625
W-WNW	0.700		0.500	0.550	0.600	0.650	0.675

Table 3(c). Effect of Factors X_7 and X_8 on the Average Weight A_8

A_8 / X_8	X_7 / Grp. dist. wgt.	$X_7<21$	$21\leqslant X_7<24$	$24\leqslant X_7\leqslant 29$	$29<X_7<32$	$32\leqslant X_7$
		0.400	0.600	0.700	0.900	0.350
Group dist.	weight					
$X_8<104$	0.30	0.350	0.450	0.500	0.600	0.325
$104\leqslant X_8\leqslant 110$	0.60	0.500	0.600	0.650	0.750	0.475
$110<X_8<115$	0.70	0.550	0.650	0.700	0.800	0.525
$115\leqslant X_8\leqslant 121$	0.75	0.575	0.675	0.725	0.825	0.550
$121<X_8$	0.20	0.300	0.400	0.450	0.550	0.275

Table 3(d). Effect of Factors X_6 and X_{12} on the Average Weight A_9

A_9 / X_{12}	X_6 / Grp. dist. wgt.	$X_6<12$	$12\leqslant X_6\leqslant 15$	$15<X_6\leqslant 18$	$18<X_6\leqslant 21$	$21<X_6$
		0.150	0.350	0.550	0.600	1.000
Group dist.	weight					
$1.0\leqslant X_{12}$	0.35	0.250	0.350	0.450	0.475	0.675
$0\leqslant X_{12}<1.0$	0.40	0.275	0.375	0.475	0.500	0.700
$-1.0\leqslant X_{12}<0$	0.50	0.325	0.425	0.525	0.550	0.750
$-1.5\leqslant X_{12}<-1.0$	0.70	0.425	0.525	0.625	0.650	0.850
$-1.5>X_{12}$	0.75	0.450	0.550	0.650	0.675	0.875

Table 3(e). Correction Factor, C

Distance (longitudinal) from Xisha	<4.0	4.0—8.0	8.0<
Correction factor	0.05	0.100	0.275

Fill in each calculated value of S on a statistical chart of whether the typhoon or low pressure system lands.

Determine the critical value y = 2.2. If $y \geq 2.2$, then the typhoon (low pressure system) lands; if not, it does not land.

Historically, the accuracy has been 95/112 = 84.8 percent.

2. Predicting the Location of Landing

To determine the landing location of the 60 typhoons and low pressure systems which landed, select the factors X_1, X_6, X_7, X_8, X_9, and X_{10} and complete the squares on the following table (Table 4).

Table 4(a). Effect of Factors X_1 and X_9 on the Average Weight A_{10}

A_{10} / X_9 \ X_1	Group dist.	$X_1 \leqslant -1.5$	$-1.5 < X_1 < 1.0$	$1.0 \leqslant X_1 \leqslant 5.0$	$5.0 < X_1$
	wgt.	0.750	0.600	0.500	0.400
Group dist.	weight				
$X_9 < 584$	0.300	0.525	0.450	0.400	0.350
$584 \leqslant X_9 < 586$	0.600	0.675	0.600	0.550	0.500
$586 \leqslant X_9 < 588$	0.350	0.550	0.475	0.425	0.375
$588 \leqslant X_9$	0.000	0.375	0.300	0.250	0.200

Table 4(b). Effect of Factors X_7 and X_8 on the Average Weight A_{11}

A_{11} / X_8 \ X_7	Group dist.	$X_7 \leqslant 22$	$22 < X_7 < 25$	$25 \leqslant X_7 < 29$	$29 \leqslant X_7$
	wgt.	0.850	0.300	0.500	0.600
Group dist.	weight				
$X_8 \leqslant 104$	0.400	0.625	0.350	0.450	0.500
$104 < X_8 < 115$	0.550	0.700	0.425	0.525	0.575
$115 \leqslant X_8 \leqslant 120$	0.700	0.775	0.500	0.600	0.650
$120 < X_8$	0.300	0.575	0.300	0.400	0.450

Table 4(c). Effect of Factors X_{10} and X_6 on the Average Weight A_{12}

A_{12} / X_6 \ X_{10}	Group dist.	W-WNW	NW-NE	ENE-S	SSW-WSW
	wgt.	0.300	0.800	0.550	0.500
Group dist.	weight				
$X_6 < 15$	0.400	0.350	0.600	0.475	0.450
$15 \leqslant X_6 \leqslant 17$	0.450	0.375	0.625	0.500	0.475
$17 < X_6 \leqslant 20$	0.700	0.500	0.750	0.625	0.600
$20 < X_6$	0.750	0.525	0.775	0.650	0.625

Table 4(d). Correction Factor, C

Distance (longitudinal) from Xisha	<5.0	5.0—7.0	>7.0
Correction factor	0.1	0.08	0.05

Fill in each calculated value of S on a statistical chart of the location of the landing of the typhoon or low pressure system.

Determine the critical value y = 1.7. If $y \geq 1.7$, then the typhoon (low pressure system) lands in Aodong; if not, it lands in Aoxi.

Historically the accuracy has been 56/60 = 93.3 percent.

3. Predicting the Direction of Motion of Typhoons and Low Pressure Systems That Do Not Land

Whether the typhoon moves east, west or disperses at sea depends on factors of atmospheric energy and cold air and the westernmost position of secondary highs. Select the factors X_1, X_5, X_6, and X_8 and differentiate among the 52 typhoons and low pressure systems that did not land as to whether they moved east or west (including those that dispersed at sea). Arrange them in a chart to carry out statistics, calculate the resulting critical value y = 1.3. If $y \geq 1.3$, then the typhoon (low pressure system) is of the east moving type; if not, it is of the west moving type. Historically, the accuracy has been 50/52 = 96.2 percent. Then, select the factors X_2, X_3, X_5, and X_{12} and differentiate among the 43 typhoons and low pressure systems as to whether they move west or disperse at sea. Arrange them in a chart to carry out statistics and calculating the resulting critical value y = 1.3. If $y \geq 1.3$, the typhoons (low pressure systems) disperse at sea; if not, they move west to 110°E. Historically, the accuracy has been 39/43 = 90.6 percent.

V. Testing and Reporting Results

1. Forecasting Procedure

Each time a tropical low pressure system forms in the South China Sea or enters the reporting line of the western Pacific, first find each factor value from Table 1, and from the table calculate a value for S, to predict whether it will develop into a typhoon. The second step is to find the factor values from Table 3, calculate a value for S, and predict whether it will land. Finally, statistically, calculate a value for S, and determine the location of landing and predict the direction of motion of the typhoons (low pressure systems) that do not land.

2. Testing and Reporting Results

We carried out testing and verification on 9 typhoons and low pressure systems which occurred from June to October 1969; their average accuracy was 89.9 percent. We tested and reported on 8 typhoons and low pressure systems from June to August 1980. The accuracy of whether or not they would develop into typhoons was 87.5 percent; forecasting accuracy of the direction of movement of typhoons (low pressure systems) that did not land was 100 percent. Average accuracy was 93.3 percent (see Table 5).

VI. Brief Summary

The methods and results of the steps presented in this work to predict the formation and direction of motion of typhoons have many problems that merit investigation.

Table 5. Comprehensive Forecasting of the Formation and Development of Typhoons (Low Pressure Systems) From June to August 1980, Using the Weighted Addition Method

Typhoon Serial No.	Whether it develops into a typhoon			Whether it lands			Where it lands			Direction of movement of typhoons (low pressure) that do not land						Average accuracy
										Direction category			West or disperse			
	Forecast	Actual	Acc	Fore.	Actual	Acc	Fore.	Actual	Acc	Fore.	Actual	Acc	Fore.	Actual	Acc	
8005	Develop	Typhoon	0	Land	Landed	0	Aoxi	Hainan	0							
South China Sea low pressure (6.30-7.2)	Not develop	Low pressure	0	Not land	Not landed	0				West moving	Dis-persed	0	Dis-perse	Dis-persed	0	
8006	Develop	Typhoon	0	Land	Landed	0	Aodong	Swatow	0							
8008	Develop	Typhoon	0	Land	Landed	0	Aoxi	Yang jiang	0							
8007	Develop	Typhoon	0	Land	Landed	0	Aoxi	Xuwen	0							
8009	Develop	Typhoon	0	Land	Landed	0	Aoxi	Lufeng	X							
8011	Develop	Typhoon	0	Land	Landed	0	Aoxi	Dianbai	0							
South China Sea low pressure (8.27-31)	Develop	Low pressure	X	Land	Landed	0	Aoxi	Yaxian	0							
Accuracy	87.5 percent			100 percent			85.7 percent			100 percent						93.3 percent

Note: "0" indicates forecasting accuracy; "X" indicates forecasting error.

1. This work used the key factors of the day and the day before a tropical low pressure system formed in the South China Sea (or when a typhoon or low pressure system from the Pacific Ocean entered the reporting line), and did not consider the route and seasonal conditions of the typhoons (or low pressure systems), to more directly forecast the formation, development and landing of the typhoon. We do not forecast the speed with which the typhoon develops or the speed of movement. This needs continued research.

2. The weighted contribution of each of the forecasting targets and forecasting factors used in this method were rationally decided upon, and we consider the formation and development of the typhoon is the comprehensive result of many mutually effective factors. Thus, more objectivity will produce more ideal forecasting. But, how to use more suitable factors as the key elements influencing the forecasting targets is deserving of deep research.

3. In the mathematical statistics of forecasting, the selection of the forecasting factors is a problem deserving of deep investigation. Although the factors selected in this work can indicate certain weather characteristics, and can also clarify meteorological concepts, and their forecasting targets are also closely associated with physical processes, however, due to deficiencies in current data, a small representative surface is, in the final analysis, inadequate for success.

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PHYSICAL SCIENCES

USE OF AOU IN MIDDLE, DEEP WATER CIRCULATION IN SOUTH CHINA SEA

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[Article by Wu Linxing [0702 2651 5281] of the Chinese Academy of Sciences, South China Sea Institute of Oceanography; paper received 15 Mar 81]

[Text] For technological reasons, direct determination of water circulation in the middle and deep layers of the sea is very difficult. Generally, high level dynamic calculations are adopted and combined with estimations based on chemical parameters (for example, C^{14} and O_2). A description of circulation in the South China Sea was given in a NAGA report by Wyrtki[3] (1960). Zhu Zuyou [4281 4371 0147][1] (1972) also discussed circulation in the Bashi Channel in an article in "Exchange in Water Flows Between the Pacific Ocean and the South China Sea." They consistently consider that the deep water of the Pacific passes through the Bashi Channel and enters the South China Sea while the surface layer flow is greatly influenced by the monsoons. This work utilizes A.O.U. [apparent oxygen utilization] in a preliminary inquiry of the circulation patterns in the middle and deep water layers of the South China Sea.

I. Principles

Experimental data from several voyages make clear that the lowest salt content of the South China Sea is in the middle layer, centered at a depth of approximately 500 meters. But, below 1200 meters, the water composition is very evenly distributed, the water temperature in the deep layers of the Pacific is lower by 4°C, and the salt content is between 34.50 and 34.60 per thousand. This work assumes water at a depth of approximately 500 meters to be representative of the middle layer. Because the data from depths greater than 1200 meters is relatively sparse, water at approximately 1200 meters is taken to be the deep layer. The average value of σ_t at 500 meters is 26.79 and at 1200 meters it is 27.50.

II. Data

The South China Sea Institute of Oceanography of the Chinese Academy of Sciences "Shi Yan Hao" in June and July of 1978 and June and July of 1979

differentiated between the middle section and the northeast section of the South China Sea and researched those ocean areas obtaining a large amount of data. The summer circulation situation discussed in this work is based principally on the data from these two voyages. In addition, some data was used from the National Oceanographic Office "Xiang Yang Hong #3" in July 1976, in the ocean areas north of the Xisha and Zhongsha Archipelagos (for middle layer data only) and Taiwan University "Li Lian Hao" in August 1971 in the eastern areas of the South China Sea near the Philippines. In order to make up for the shortcoming in data for this season in ocean areas in the vicinity of the Zhongsha and Xisha Archipelagos, relevant data from the South China Sea Institute of Oceanography of the Chinese Academy of Sciences "Hong Qi #088" in May 1976, in research on this ocean area was referenced. Figure 1 shows the path of each voyage.

III. Results

Differentiation between the σ_t values at 500 and 1200 meters in the central section of the South China Sea (Figures 2 and 3) and the temperature, salt content, and A.O.U. value distribution lines of the σ_t 26.79 and σ_t 27.50 surfaces (Figures 4-9) are shown. Figures 10 and 11 are diagrams of the circulation in these two surfaces (the thickness of the front indicates the intensity of the circulation).

The A.O.U. distribution curve clearly indicates that the fundamental trends at the two surfaces with σ_t values of 26.79 and 27.50 are the same. In the eastern ocean areas, it progressively increases from north to south. At the entrance to the Bashi Channel, between 20° and 22°N there is a tongue of low A.O.U. value water which extends to the vicinity of the Dongsha Archipelago. But, the A.O.U. values at the southern tip of the Dongsha Archipelago are high compared to the southwestern areas which are even more southern. In other words, north of the Dongsha and the Xisha Archipelagos, at 18°N, 114°E, is the center of low A.O.U. values. Off the western coast of Luzon Island in the Philippines, there is also an area of high A.O.U. values (in the vicinity of 17°N, 119°E). To the south of the Xisha Archipelago, the A.O.U. values again progressively increase in the direction of the Vietnam coast. Moreover, in the southeast, near the entrance to the Sulu Sea between Mindoro Island and Palawan Island, the A.O.U. value is relatively low.

IV. Discussion

Increases in A.O.U. value indicate the direction of water movement as the water goes from "young" to "old" as more biological oxidation occurs. However, we are still unable to provide the distinction between advection and mixing processes since A.O.U. is not only related to biological oxidation, but also is affected by mixing. Because of this, discrepancies in the productive forces of the surface layer could also give rise to discrepancy in the oxidation rate in the deep layers.

Regarding the distinction between advection and mixing processes, we can analyze parameters on a σ_t surface such as salt content and temperature. These parameters are only affected by runoff, precipitation and water mixing, and are not affected by biological activity.

From the distribution lines for salt and temperature and other parameters of the two σ_t surfaces, we can see that the water is relatively stable. On the 26.79 σ_t surface from the entrance to the Bashi Channel to the southeast section of the Dongsha Archipelago and heading south (slightly to the southwest) to the middle of the broad ocean area, the temperature is between 8.30 and 8.40°C and the salt content is 34.42 to 34.44 per thousand. This is extremely consistent with the indication of current direction by the A.O.U. level. Moreover, at the northern section of the Zhongsha Archipelago, at 114°E, 18°N, there is a center of high salt and high water temperature, its temperature and salt level each progressively decrease in a northeasterly direction until it reaches the southern side of the Dongsha Archipelago. This is also the direction of progressively increasing A.O.U. levels. On the 27.50 σ_t surface, the temperature and salt distribution is relatively even. Temperatures are generally from 3.50 to 3.70°C. Salt contents are between 34.55 and 34.57 per thousand. We do not see evidence that very turbulent vertical mixing is taking place.

Zhu Zuyou[1], in his discussion of the exchange of waters of the Pacific Ocean and the South China Sea, used the trigonal method of mixing to calculate the main composition of black tide water, middle layer water, and deep layer water from the Pacific Ocean in the surface, middle and deep layer waters at each site of the South China Sea. For example, at 11°27.1'N, 114°12.1'E, the black tide water in the surface layer (σ_t 25.5) was 54 percent, Pacific Ocean middle layer water in the middle layer (σ_t 26.5-27.0) was 58-70 percent, at σ_t 26.79 it was 64 percent, and in the deep layer (σ_t 27.50) the Pacific Ocean deep layer water was 78 percent. In other words, from the entrance of the Bashi Channel, after flowing southwest for more than 1,000 km, the water originating in each layer of the Pacific Ocean makes up more than half the total. Moreover, at increasing depths, the influence of the mixing effect becomes increasingly small. Therefore, at the two levels of σ_t 26.79 and σ_t 27.50, the A.O.U. basically indicates the direction of water movement.

In addition, one can carry out analysis from the density distribution. H.U. Sifeidelupu [2448 6316 1795 7627 2528] et al.[2] point out, in the northern hemisphere "where there are sea currents, relatively low density sea water is located on the right side of the direction of current and relatively high density sea water is on its left." Figures 2 and 3 show the density at 500 and 1200 meters; at the entrance to the Bashi Channel it is roughly low in the north and high in the south and the current flows from east to west. Also, the sea surface at the eastern section of ocean south of the Dongsha Archipelago basically has a density which is high in the east and low in the west and the current flows from north to south. In the southern section of the Xisha Archipelago, from 113°E and west, just opposite the eastern section, the density at 500 meters progressively increases as one goes west and the current flows from south to north. This is basically consistent with the A.O.U. values which indicate that the direction of the sea current is toward the Vietnam coast. Moreover, in the northern section of central Xisha Archipelago, from 18°N, 114°E, northeast to the southern tip of the Dongsha Archipelago, it can also be seen that its density appears high in the northwest and southeast sections, and the sea current appears to be in a northeasterly direction. This appears to be consistent with the direction of

circulation as indicated by the A.O.U. values. Additionally, on the western coast of Luzon Island in the Philippines and near the entrance to the Sulu Sea there is a similar situation. The density at 1200 meters near the Vietnam coast is similar to that in the eastern ocean areas. It is possible that the circulation in this area is weaker. This is a similar situation to that at 500 meters and other levels.

Zhong Huanliang [6988 2970 5328] (Footnote 1) (Zhong Huanliang, 1979, preliminary investigation of circulation in the northern ocean area of the Zhongsha and Xisha Archipelagos, Ocean Scientific and Technological Data, No 7, pp 1-23, National Oceanographic Office Ocean Scientific and Technological Information Research Institute) (1979) used high level dynamics to calculate the circulation in the ocean area north of the Zhongsha and Xisha Archipelagos. He discovered a water layer with inverted circulation at 400 meters. The direction of current in the vicinity of 18°N, 114°E is quite similar to the direction of current in our σ_t 26.79 surface (Figure 12). Xu Xizhen [1776 6932 4394] (Footnote 2) (Xu Xizhen, 1978, middle layer of the South China Sea circulation and exchange with outside waters, unpublished) (1978) described the winter and summer patterns of circulation in the middle layer (500 meters) of the South China Sea based on the isobath distribution and other hydrologically important distributions of the σ_t surface. The closed horizontal circulation in the summer is of the anticyclone type (Figure 13). The indication of A.O.U. values in the present work is basically similar to this circulation pattern. Only near the eastern Philippine coast are there indication of weak flow in the direction of the coast according to A.O.U. values. It is possible that nutrients are relatively abundant near the coast giving rise to high A.O.U. values or the GM-85 model oxygen analyzer used by "Jiu Lian Hao" gave oxygen measurements with consistently low bias giving rise to deviations in the A.O.U. computations. However, there is the data report that the flow is increased here and, thus, the flow direction affects the horizontal circulation.

There is no additional data for comparison with the deep water layer data. However, going through a few conservative composition and density analyses, we could consider that the A.O.U. levels all basically indicate that the deep layer circulation is generally stable.

Of course, since we failed to carry out simultaneous observations and also since all data we used was taken at the same time of the month, and there was a definite time interval, adding different observations using different methods to obtain data discrepancies, calculation results cannot avoid having certain errors. Because of this, the circulation directions as indicated in this work by A.O.U. are relatively crude.

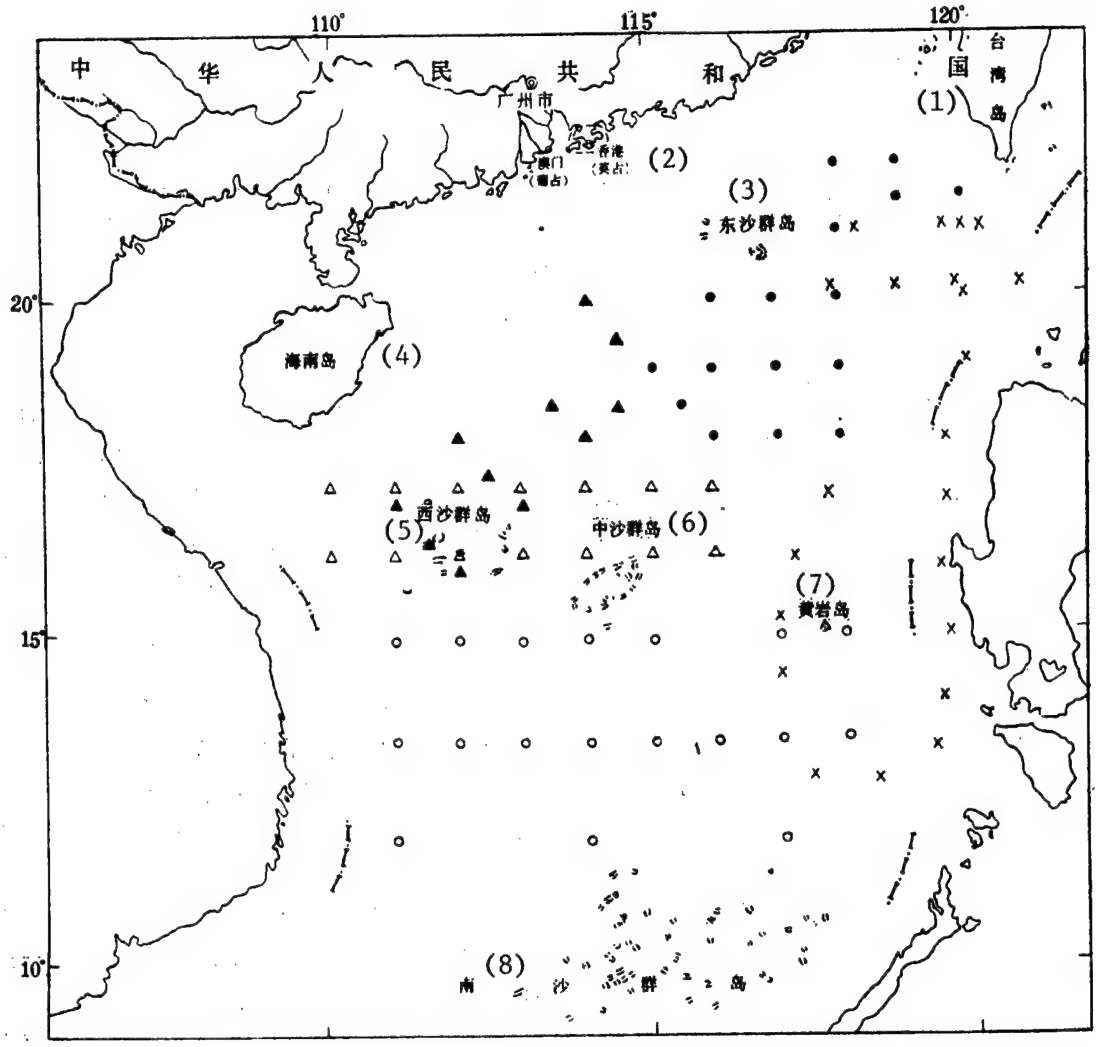

Figure 1. Map of the north central part of the South China Sea showing the sites of the voyages from which data used in this work was obtained.
o "Shi Yan Hao" (June, July 1978); ● "Shi Yan Hao" (June, July 1979); ▲ "Xiang Yang Hong Hao" (July 1976); Δ "Hong Qi #088" (May 1976) and "Jiu Lian Hao" (August 1971)

Key:

1. Taiwan
2. Hong Kong
3. Dongsha Archipelago
4. Hainan Island
5. Xisha Archipelago
6. Zhongsha Archipelago
7. Huangyan Island
8. Nansha Archipelago

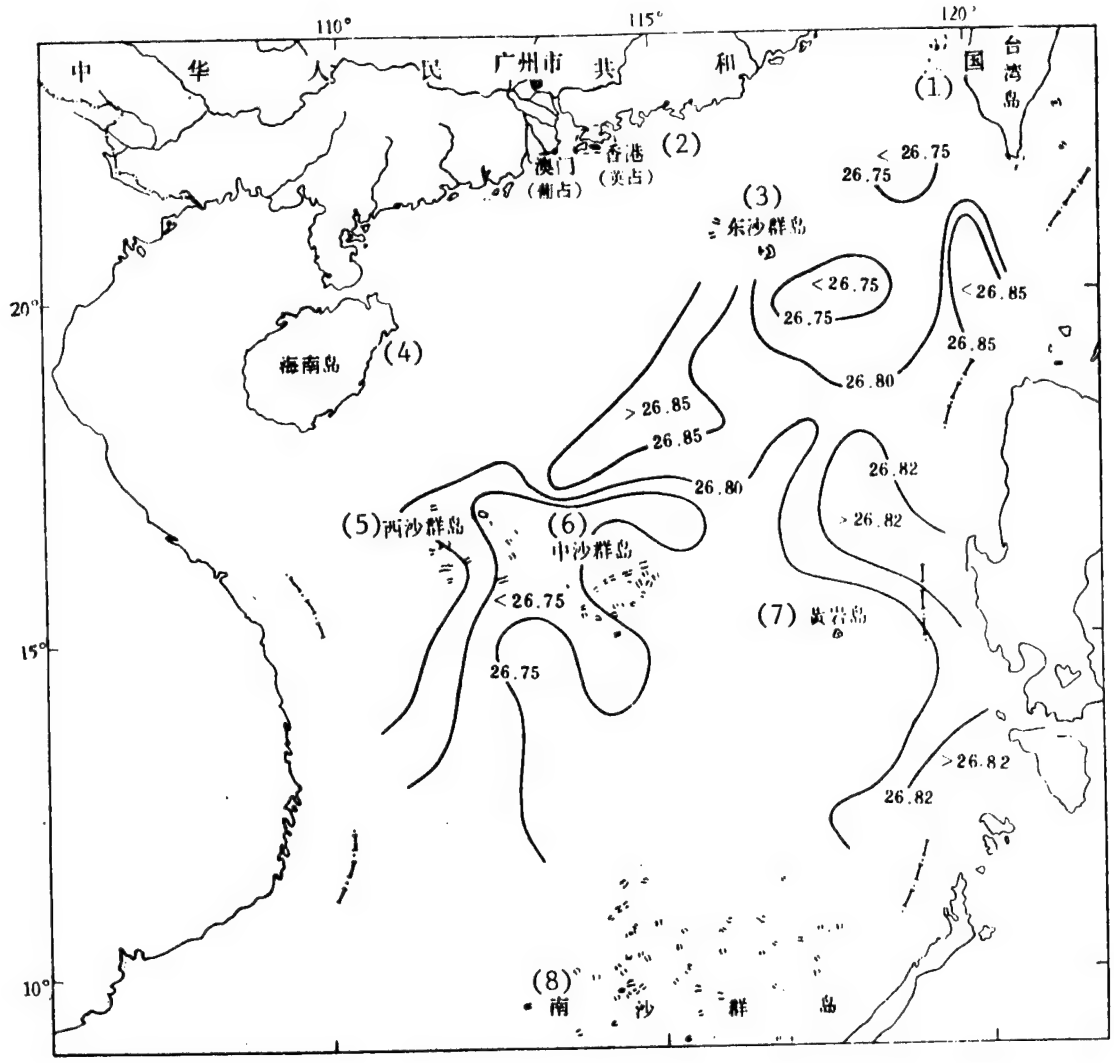

Figure 2. σ_t distribution at the 500 meter layer of the north central South China Sea

Key:

1. Taiwan
2. Hong Kong
3. Dongsha Archipelago
4. Hainan Island
5. Xisha Archipelago
6. Zhongsha Archipelago
7. Huangyan Island
8. Nansha Archipelago

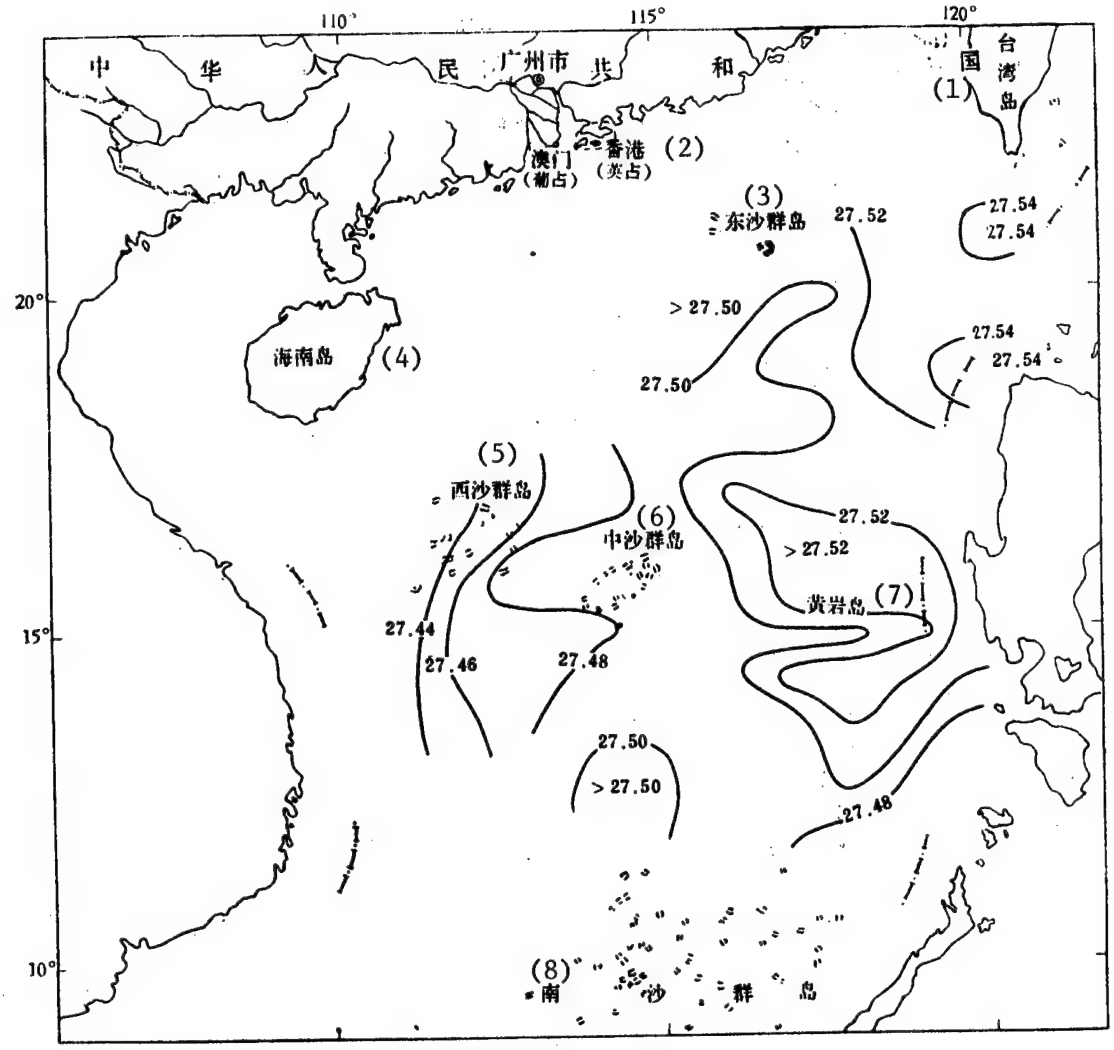

Figure 3. σ_t distribution at the 1200 meter layer of the north central South China Sea

Key:

1. Taiwan
2. Hong Kong
3. Dongsha Archipelago
4. Hainan Island
5. Xisha Archipelago
6. Zhongsha Archipelago
7. Huangyan Island
8. Nansha Archipelago

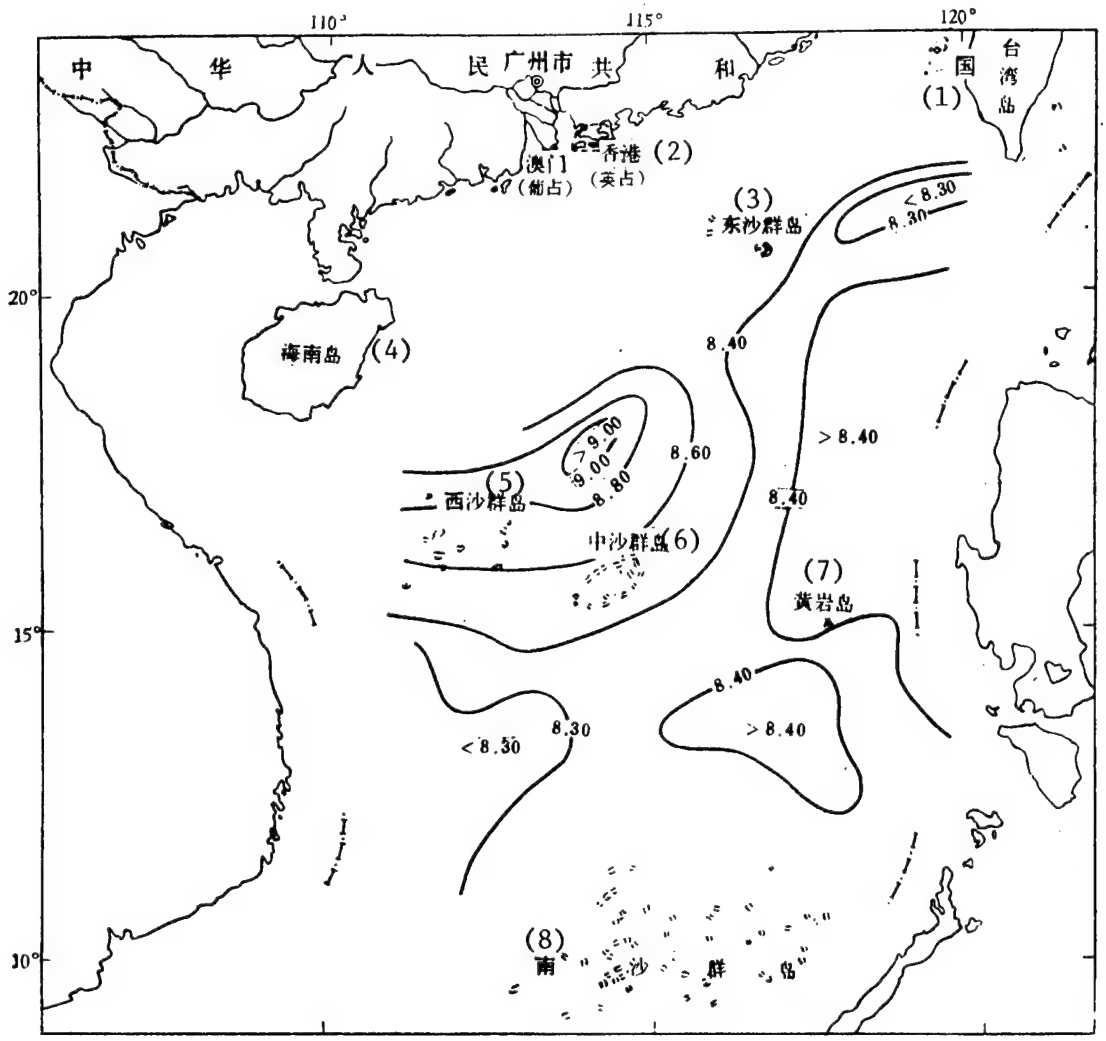

Figure 4. σ_t 26.79 surface temperature distribition (°C) in the north central South China Sea

Key:

1. Taiwan
2. Hong Kong
3. Dongsha Archipelago
4. Hainan Island
5. Xisha Archipelago
6. Zhongsha Archipelago
7. Huangyan Island
8. Nansha Archipelago

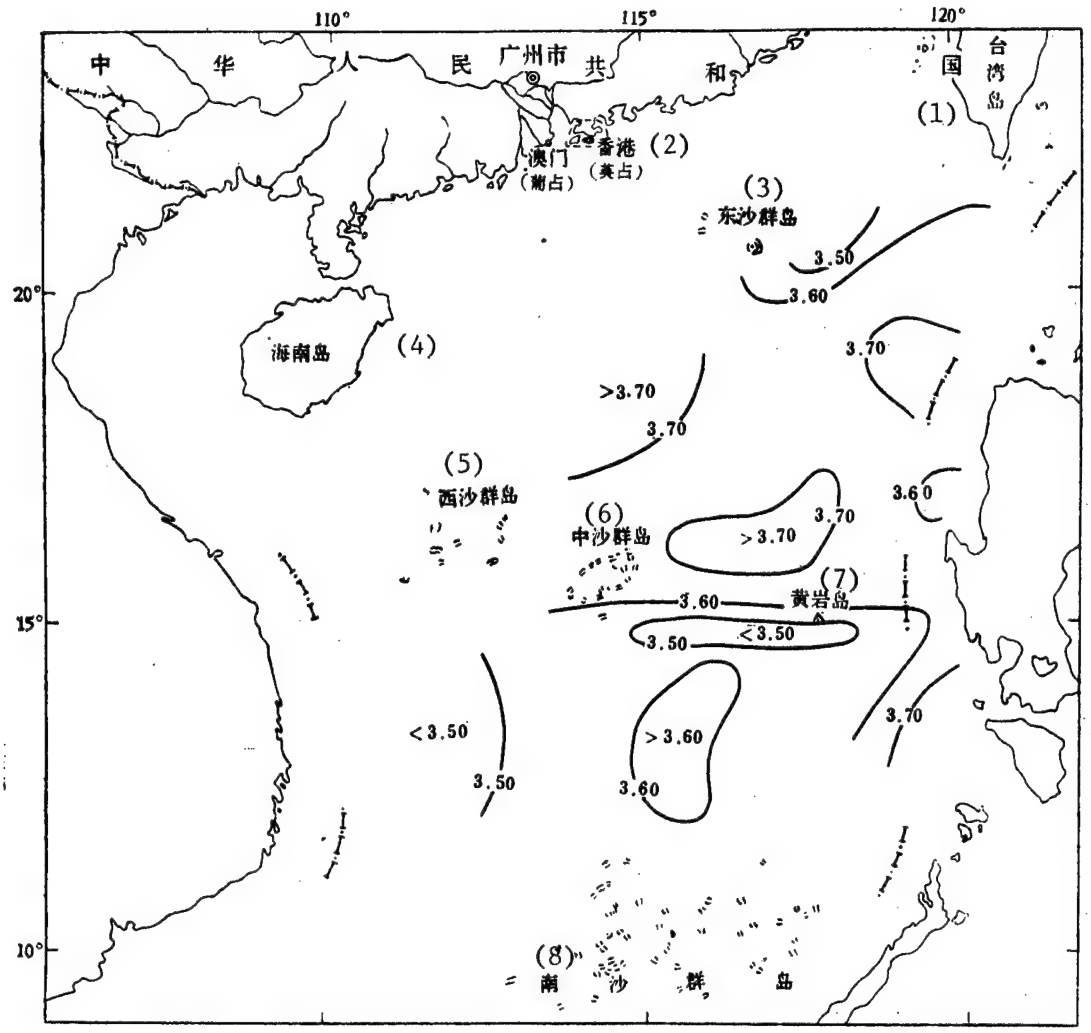

Figure 5. σ_t 27.50 surface temperature distribution (°C) in the north central South China Sea

Key:

1. Taiwan
2. Hong Kong
3. Dongsha Archipelago
4. Hainan Island
5. Xisha Archipelago
6. Zhongsha Archipelago
7. Huangyan Island
8. Nansha Archipelago

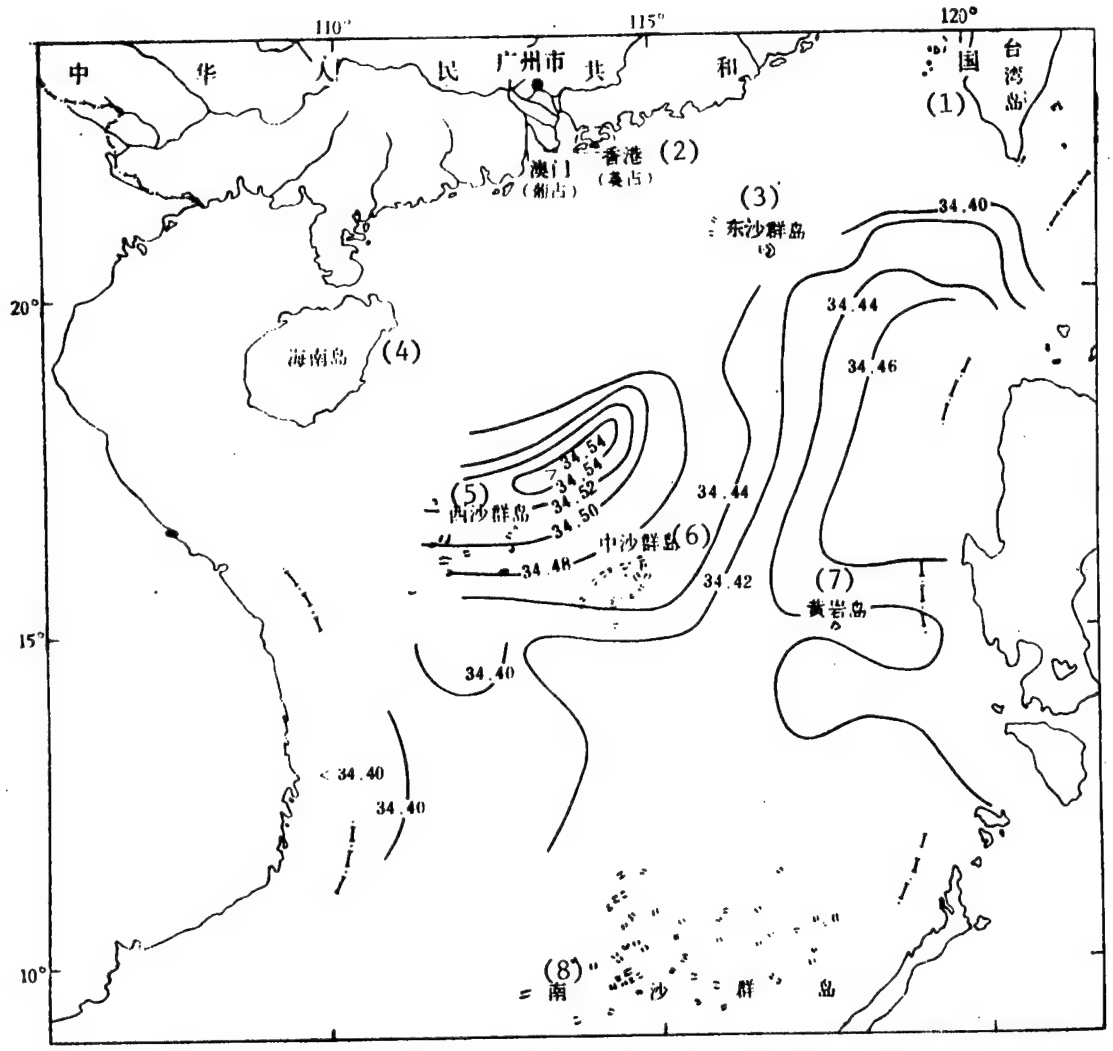

Figure 6. σ_t salt 26.79 salt content distribution (per thousand) in the north central South China Sea

Key:

1. Taiwan
2. Hong Kong
3. Dongsha Archipelago
4. Hainan Island
5. Xisha Archipelago
6. Zhongsha Archipelago
7. Huangyan Island
8. Nansha Archipelago

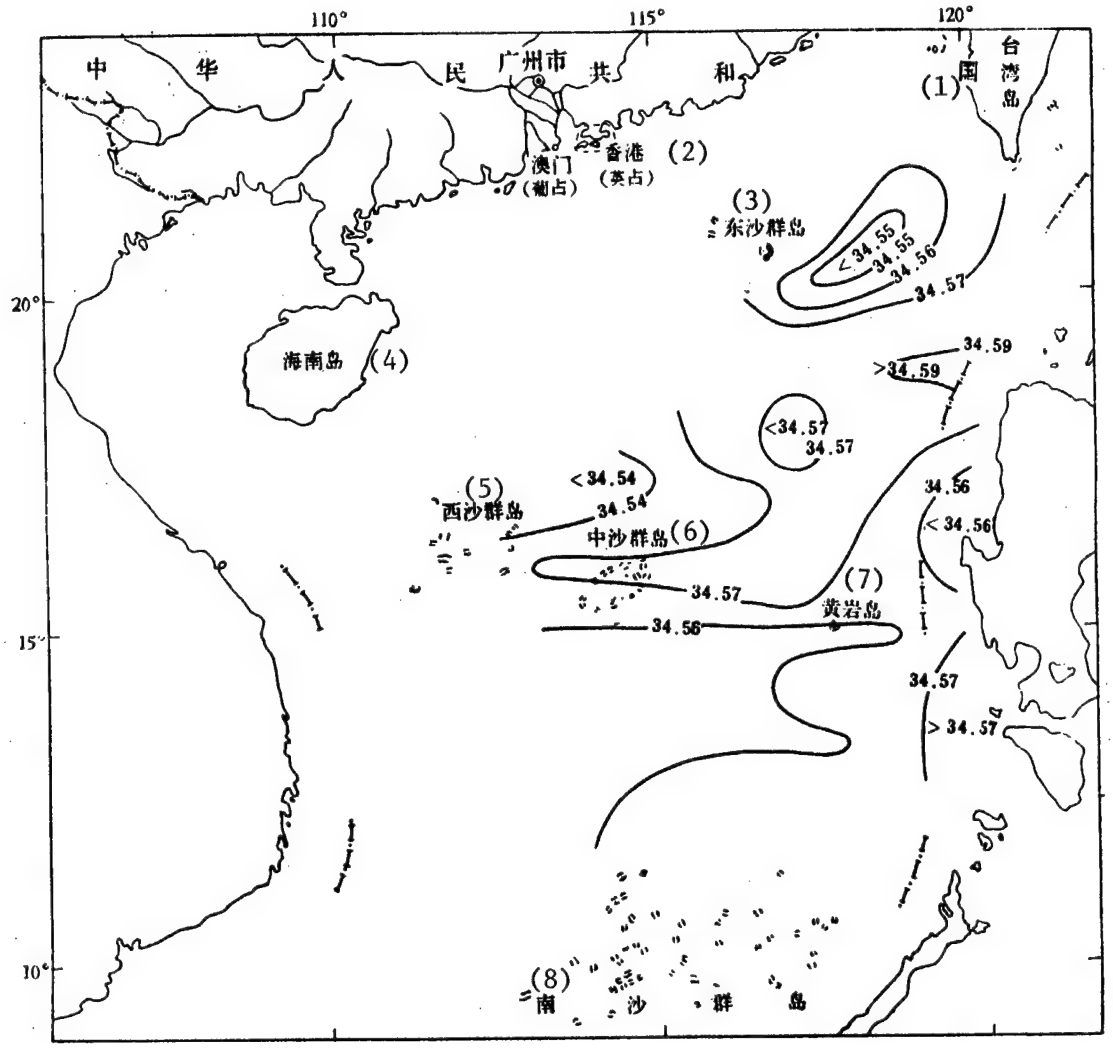

Figure 7. σ_t 27.50 salt content distribution (per thousand) in the north central South China Sea

Key:

1. Taiwan
2. Hong Kong
3. Dongsha Archipelago
4. Hainan Island
5. Xisha Archipelago
6. Zhongsha Archipelago
7. Huangyan Island
8. Nansha Archipelago

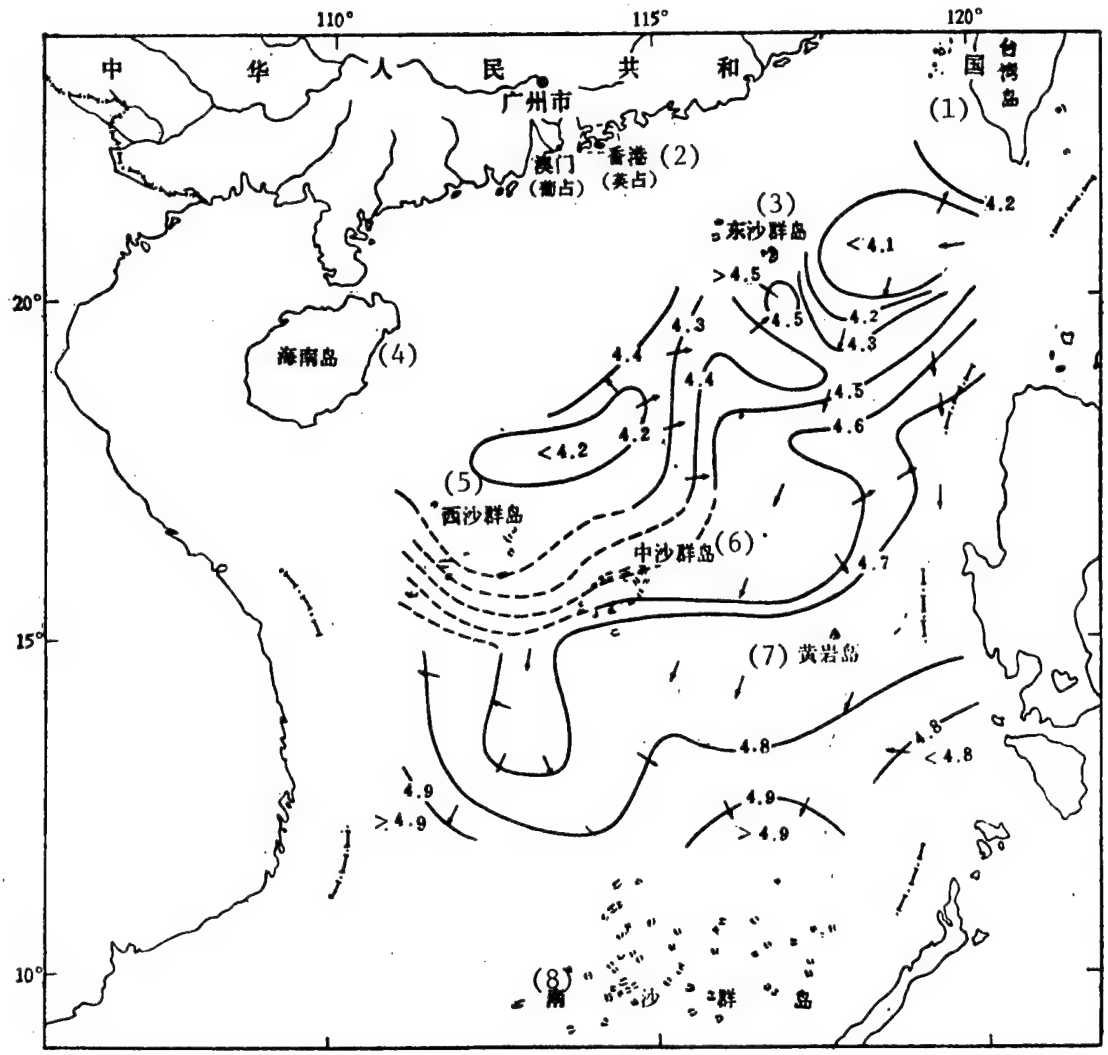

Figure 8. σ_t 26.79 A.O.U. distribution (ml/l) in north central South China Sea

Key:

1. Taiwan
2. Hong Kong
3. Dongsha Archipelago
4. Hainan Island
5. Xisha Archipelago
6. Zhongsha Archipelago
7. Huangyan Island
8. Nansha Archipelago

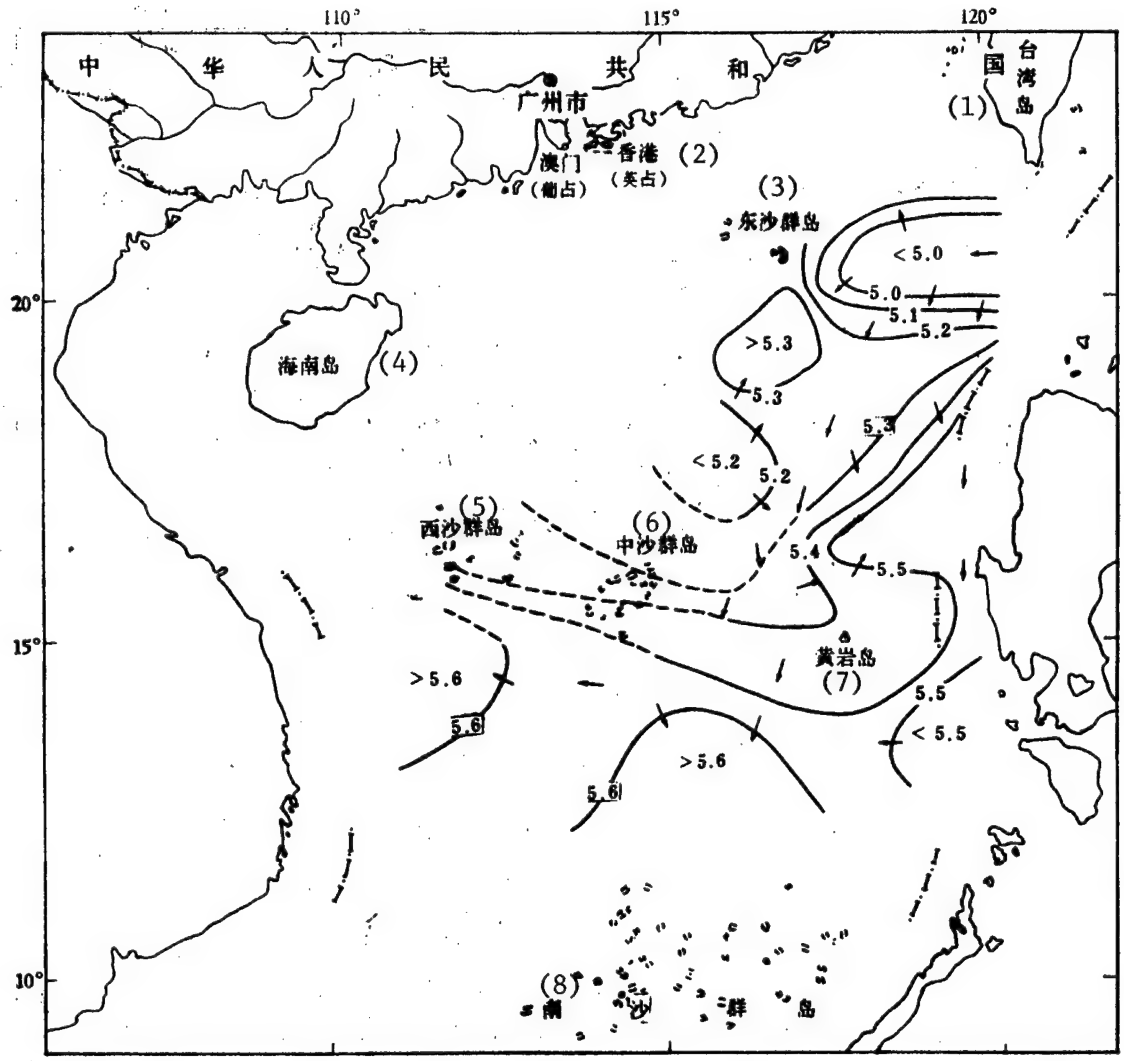

Figure 9. δ_t 27.50 A.O.U. distribution (ml/l) in north central South China Sea

Key:

1. Taiwan
2. Hong Kong
3. Dongsha Archipelago
4. Hainan Island
5. Xisha Archipelago
6. Zhongsha Archipelago
7. Huangyan Island
8. Nansha Archipelago

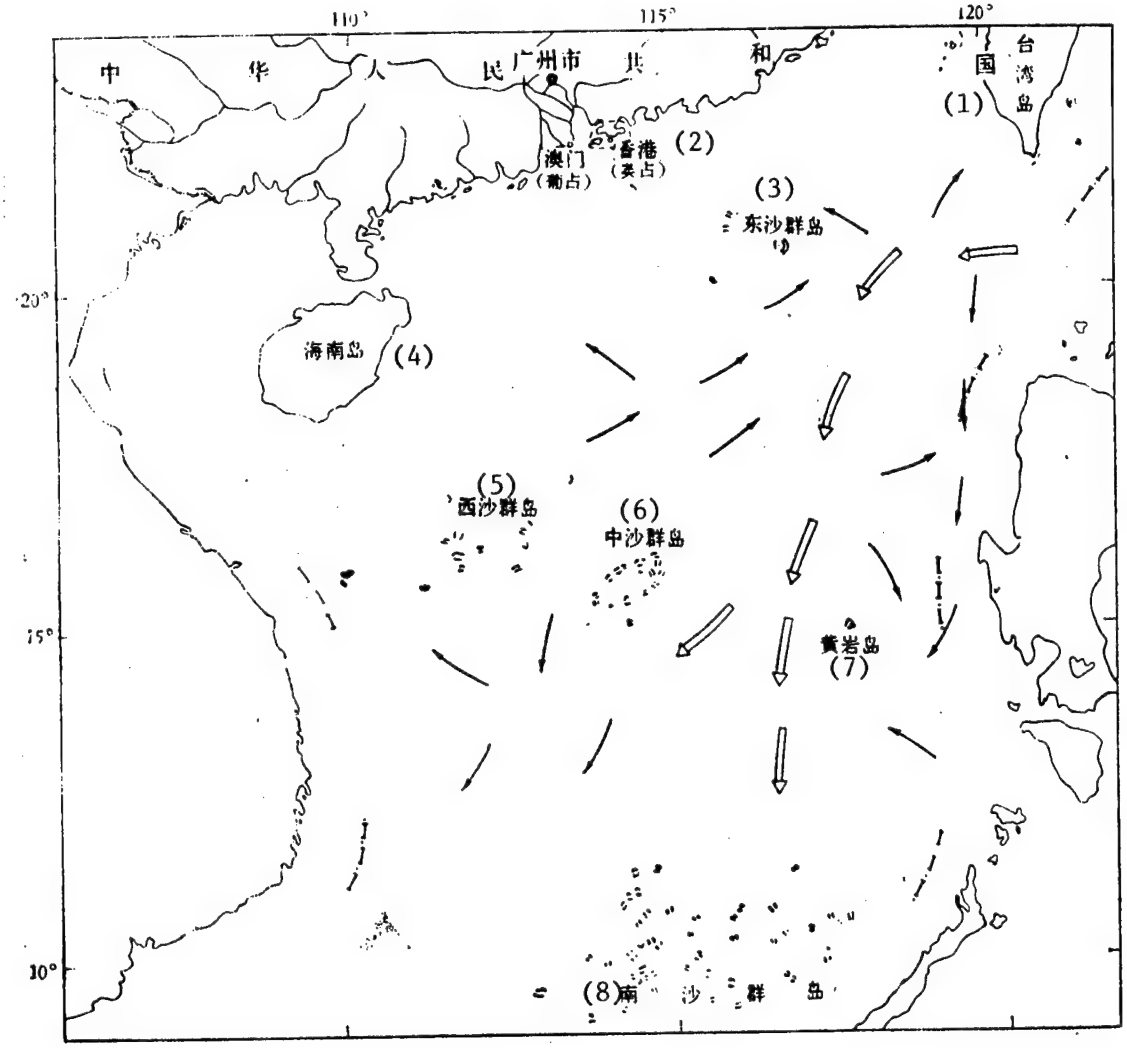

Figure 10. δ_t 26.79 circulation diagram in north central South China Sea

Key:

1. Taiwan
2. Hong Kong
3. Dongsha Archipelago
4. Hainan Island
5. Xisha Archipelago
6. Zhongsha Archipelago
7. Huangyan Island
8. Nansha Archipelago

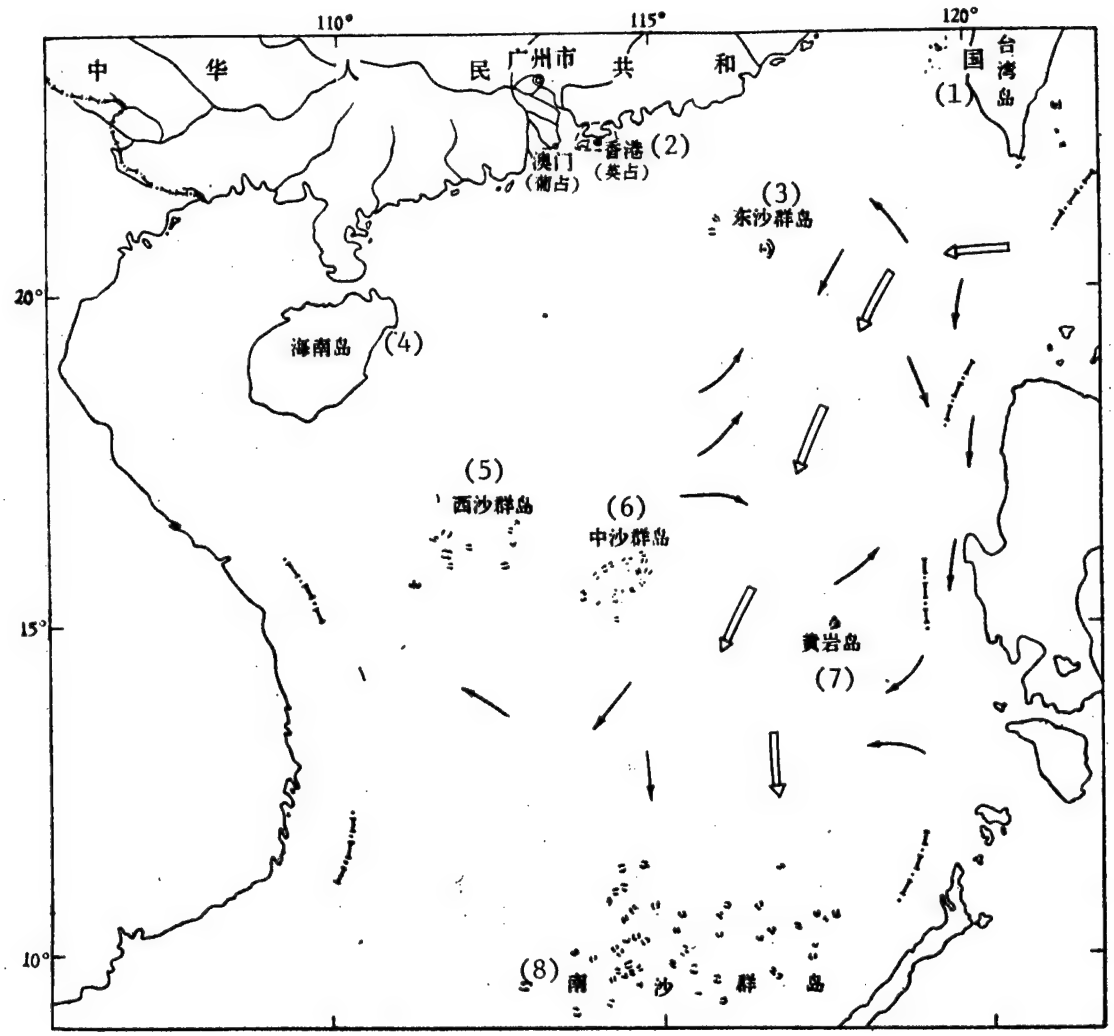

Figure 11. δ_t circulation diagram in north central South China Sea

Key:

1. Taiwan
2. Hong Kong
3. Dongsha Archipelago
4. Hainan Island
5. Xisha Archipelago
6. Zhongsha Archipelago
7. Huangyan Island
8. Nansha Archipelago

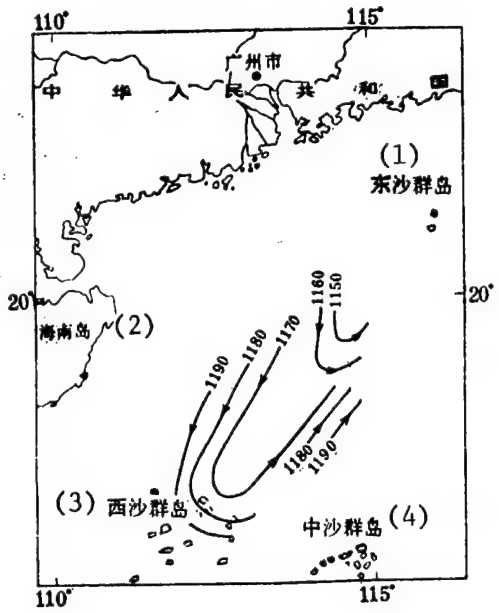

Figure 12. Map of the August 400 meter layer dynamic altitude in north central South China Sea (relative to 700 meters)

Key:

1. Dongsha Archipelago
2. Hainan Island
3. Xisha Archipelago
4. Zhongsha Archipelago

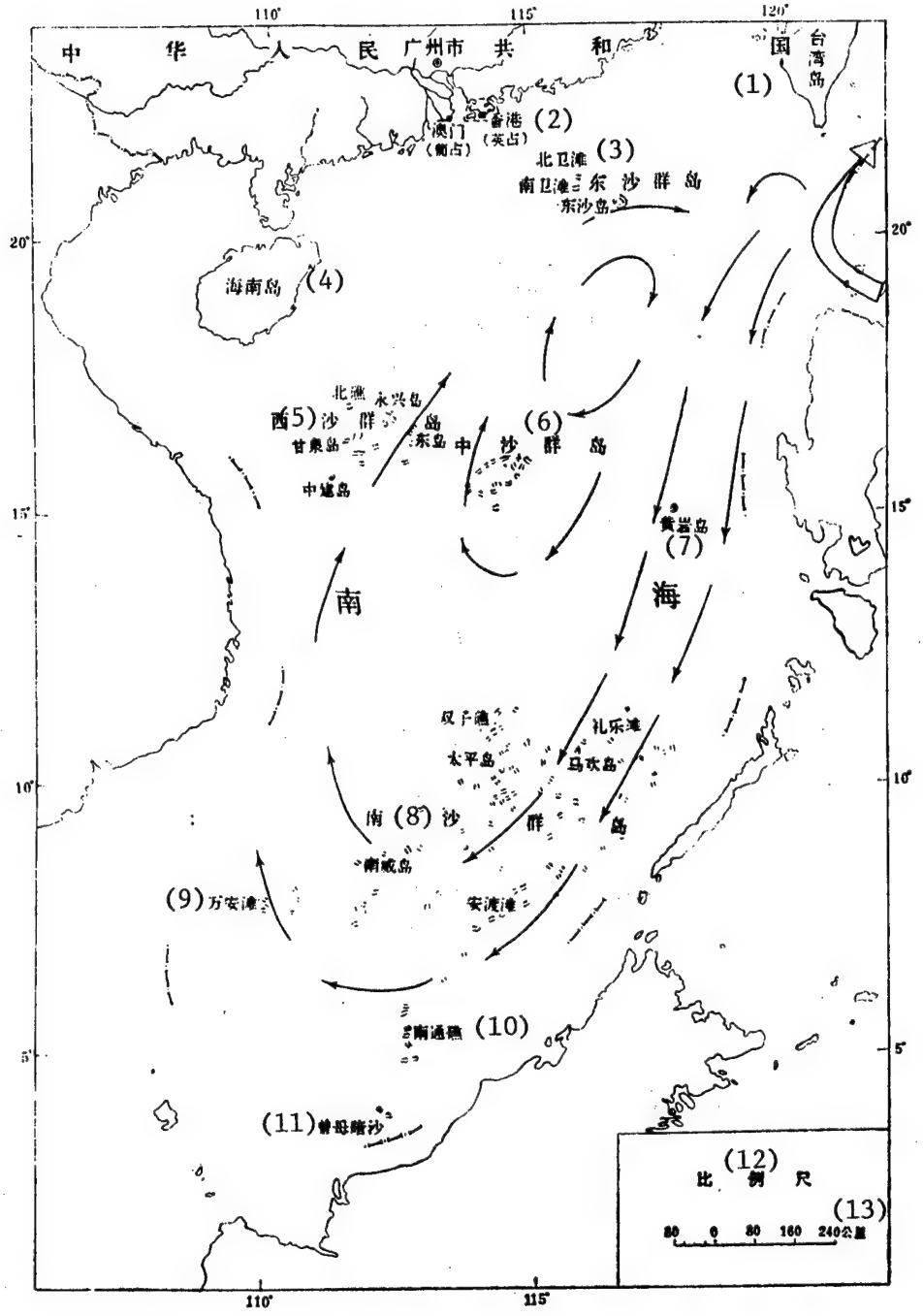

Figure 13. Map of the summer pattern of circulation in the middle layer of the South China Sea

Key:

1. Taiwan
2. Hong Kong
3. Dongsha Archipelago
4. Hainan Island
5. Xisha Archipelago
6. Zhongsha Archipelago
7. Huangyan Island
8. Nansha Archipelago
9. Wan'an Shoals
10. Nantong Reef
11. Zengmu Reef
12. Scale
13. Kilometers

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CSO: 4008/1067

APPLIED SCIENCES

SHANGHAI PLANT TURNING OUT VERSATILE ROBOT LINE

Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 22 Aug 86 p 1

[Text] [Photo caption]

A robot capable of grasping, moving, seeing, hearing, and speaking is now in batch production at the Shanghai No. 1 Machine Tool Plant. Capable of controlled body movements, this robot also has a voice synthesizer with 64 phonemes and four tones.

/7358
CSO: 4008/9

APPLIED SCIENCES

NEW-TYPE RAPID OSCILLATION, SELF-MODE-LOCKING PHENOMENON IN HIGH-GAIN LASER

Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 6, No 7, Jul 86 pp 585-591

[Article by Li Shifang [2621 0013 5364], Hu Qiquan [5170 0120 6898], and Lin Fucheng [2651 4395 2052] of the Shanghai Institute of Optics and Fine Mechanics, the Chinese Academy of Sciences; first paragraph is source supplied abstract]

[Text] Abstract: A new type of rapid oscillations and self-mode-locking phenomenon in a high-gain laser is reported. Its mechanism is due to the spatial modulation of the population inversion, which will in turn cause an intensity modulation in the time domain. The oscillation frequency equals the longitudinal mode internal $c/2\ell$.

I. Introduction

The CuCl vapor laser has a very high gain but its lower energy level is a metastable state and it is therefore a pulsed self-terminating laser. Many of the unique applications of CuCl laser have received wide attention.[1] The high gain also facilitated the investigation of a number of fundamental problems in laser physics.

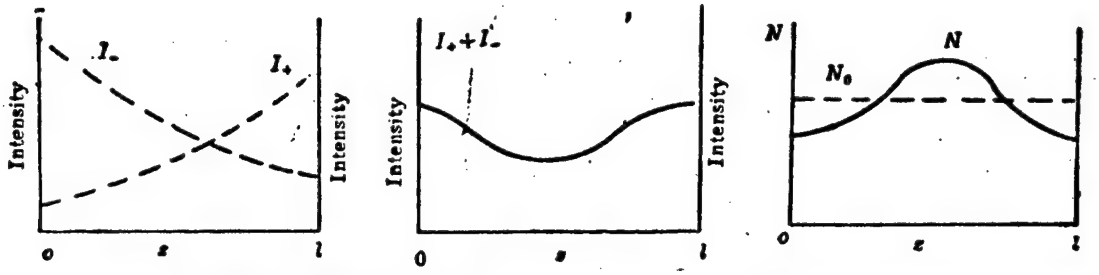
II. Theoretical Analysis

In a low Q cavity the number of particles far exceeds the threshold and two oppositely propagating light fields will produce a distribution like that shown in Figure 1(a) in the medium. In the meantime the interaction of two light fields with the population inversion causes the inverse population to assume a spatial distribution shown in Figure 1(b). The amplification of the light will therefore be space dependent.

Using the setup shown in Figure 2 for a two-level system and letting the oppositely propagating light intensities be $I_{\pm}$, the transport equation becomes

$$(\partial_t \pm c\partial_z) I_{\pm} = -\sigma N I_{\pm}, \tag{1}$$

$$\partial_t N = -2\sigma N (I_+ + I_-) - N/\tau + W_0 \tag{2}$$



(a) Spatial distribution of laser intensity in gain medium

(b) Spatial distribution of inverse population in gain region

Figure 1

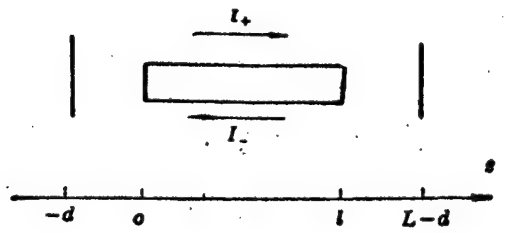


Figure 2. A model of laser used for calculation

Here we use the theory of the rate equation and N is the inverse population, a function of space and time. σ is the cross-section for stimulated emission (ignoring the energy level degeneracy), $1/\tau$ is the relaxation time, and W is a pump term.

For a zeroth order approximation, we assume the inverse population does not depend on space, i.e., $N = N_0(t)$. Substituting this into (1) and (2), we may solve for $I_{0,\pm}$ and N_0. Here $I_{0,\pm}$ are function of space and time but N_0 is only a function of time. The solution for this case is metastable; that is, the rate of change of the light intensity is smaller than the round trip time of light in the cavity.

In the first order approximation, we substitute the solution $I_{0,\pm}(z,t)$ into (2) and N will have a term that is space dependent. If $N = N_0 + \Delta N$, then ΔN is taken to be the fundamental frequency term $-mN_0 \cos kz$ of the spatial Fourier series. Here $k = 2\pi/\ell$ and ℓ is the length of the gain medium.

Assume the spatial modulation of N causes a change of $\Delta I_\pm$ in $I_\pm$, then

$$(\partial_t \pm c\partial_z)\ln I_{0,\pm}\left(1+\frac{\Delta I_t}{I_{0,\pm}}\right) \simeq (\partial_t \pm c\partial_z)\left[\ln I_0 + \frac{\Delta I_\pm}{I_{0,\pm}}\right] = cN_0\sigma(1 - m\cos kz),$$

and

$$(\partial_t \pm c\partial_z)\frac{\Delta I_\pm}{I_{0,\pm}} = -c\sigma N_0 m \cos kz.$$

Let $$x=t+z/c, \quad y=t-z/c_0$$

then

$$\partial_x \frac{\Delta I_+}{I_{0,+}} = -c\sigma N_0 m \cos\left[\frac{1}{2}k(x-y)\cdot c\right], \tag{3}$$

$$\partial_y \frac{\Delta I_-}{I_{0,-}} = -c\sigma N_0 m \cos\left[\frac{1}{2}k(x-y)\cdot c\right]. \tag{4}$$

In solving this set of equations we assume the changes in N_0 and n within one period of ΔI are small. (It will be shown below that for a period of 1 ns or so, the change in I is less than 10 percent.) So,

$$\Delta I_+ = -\frac{l}{\pi}\sigma N_0 m I_{0,+}\left[\sin kz + \sin\frac{1}{2}Rc(t-z/c)+c_+(t-z/c)\right], \tag{5}$$

$$\Delta I_- = -\frac{l}{\pi}\sigma N_0 m I_{0,-}\left[\sin kz + \sin\frac{1}{2}Rc(t+z/c)+c_-(t+z/c)\right], \tag{6}$$

where c_+ and c_- are functions to be determined.

(1) If there is no feedback, then (5) and (6) lead to

$$I_{0,+}(0, t) = \Delta I_+(0, t) = 0; \quad I_{0,-}(l, t) = \Delta I_-(l, t) = 0,$$

and hence

$$c_+(y) = -\sin\frac{1}{2}kcy, \quad c_-(x) = -\sin\frac{1}{2}kcx,$$

and the output $\Delta I_+ = \Delta I_- = 0$. There will be no oscillations in this case.

(2) If there is a feedback system, ΔI_+ and ΔI_- may be found from boundary conditions.

If the left mirror has a reflectivity r_1 and the right mirror has r_2, then (detailed derivations are given in the Appendix):

$$c_+(y) = a_+\cos\frac{1}{2}kcy + b_+\sin\frac{1}{2}kcy,$$

$$c_-(x) = a_-\cos\frac{1}{2}kcx + b_-\sin\frac{1}{2}kcx,$$

where

$$a_+ = R_1 a_-; \quad b_+ = R_1(1+b_-)-1;$$

$$(R_1\sin\varphi)a_- + (R_1\cos\varphi - R_2)b_- = R_2 - R_1\cos\varphi,$$

$$(R_1\cos\varphi)a_- - (R_1\sin\varphi)b_- = R_2\sin\varphi;$$

Here $\varphi = k(L-l)$, L is the cavity length, and R_1 and R_2 are given in the Appendix. From the equations above, it is easy to show that

$$a_- = \frac{2R_1 \sin\varphi (R_2 - R_1\cos\varphi)}{R_1^2 + R_2^2 - 2R_1R_2\cos\varphi},$$
$$b_- = \frac{(R_1^2\cos 2\phi - 2R_1R_2\cos\varphi t R_2^2)}{(R_1^2 + R_2^2 - 2R_1R_2\cos\varphi)}. \qquad (7)$$

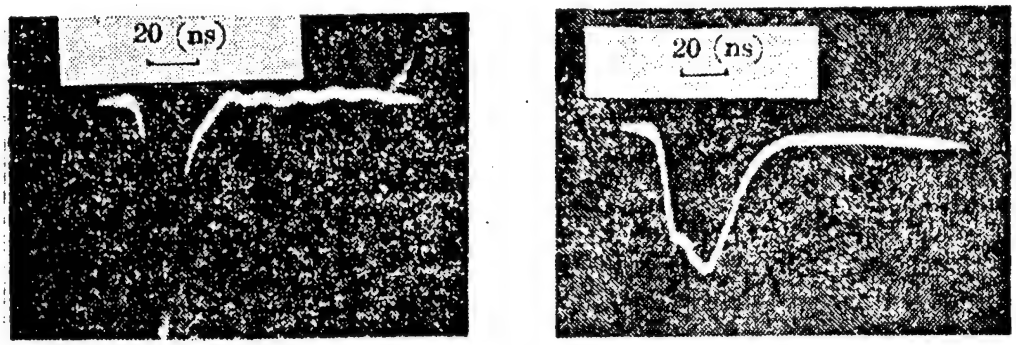
The oscillation frequency of $\Delta I_{\pm}$ is equal to 1/2 kc. Since $k = \frac{2\pi}{l}$, the oscillation frequency is

$$\nu = \frac{1}{2\pi} \cdot \frac{1}{2} kc = \frac{c}{2l}.$$

III. Experimental Verification

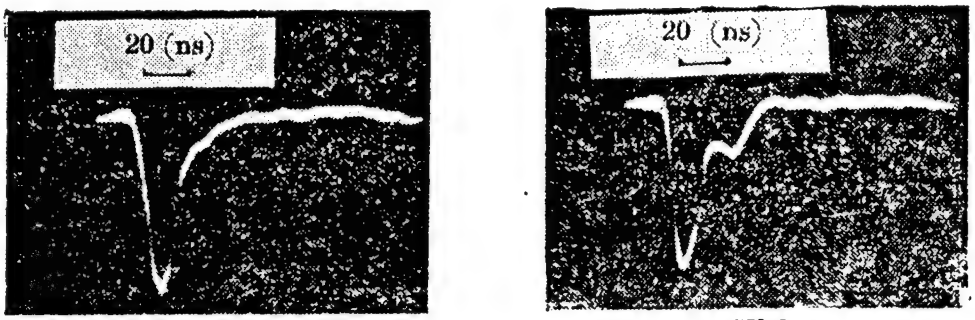
The experiment makes use of a CuCl laser[2] developed by the Shanghai Institute of Optics and Fine Mechanics. The discharge zone is 50 cm long. Figure 3(a) shows the oscilloscope trace (amplified spontaneous radiation) of the 510.6 nm and 578.2 nm fluorescence. Figure 3(b) shows the waveform of the 578.2 nm laser output with a total reflection mirror at one end of the cavity and a flat glass plate on the other end. Based on ℓ = 50 cm the theoretically expected oscillation frequency caused by the inhomogeneith is $\nu = c/2\ell$ = 300 MHz. We measure the oscillation frequency from the oscilloscope photos. The average value is 300 MHz and the statistical mean square deviation is σ = 8.9 MHz. The agreement is therefore good.

Equation (7) also shows that, when $\phi = 2\pi n$, the modulation amplitude produced by the feedback is in phase and enhanced. For example, a_- and b_- become indefinite when $R_1 = R_2$. Equation (A-8) in the Appendix shows that $R_1 - R_2$ is infinitesimal, but a_- becomes infinity when $\phi = 2\pi n$. The system then deviates far from the zeroth order approximate solution and shows self-mode-locking. Figures 4(a) and 4(b) show the 578.2 nm output laser waveform for a 120 cm long cavity with flat glass plates at the two ends. The self-mode-locking effect is quite evident and the mode-locking can sometimes reach 100 percent, as in Figure 4(b). Such instability may cause only one pulse to exist in the cavity and only one output pulse. Figure 5 shows a single laser pulse whose pulse width is limited by the equipment resolution of 1 ns. This type of self-mode-locking phenomenon is different from the "passive mode-locking" due to the absorption of unexcited atoms as reported in Ref. 3. The self-mode-locking is caused by the spatial inhomogeneity of the inverse population that results from the interaction between the excited atoms and the light field. Experimentally the self-mode-locking phenomenon is only observable in certain cavities when the cavity length and the gain length satisfy a certain relationship (generally $R_1 \approx R_2$ and $L = n\cdot\ell$, n = 2,3,...) and when the reflectivity of the mirror is low (such as 8 percent reflectivity of a glass plate). The measured repetition frequency of the mode-locked sequential pulses is 109 MHz and the ratio of the repetition frequency to the oscillation is $2.93 \approx 3$, in agreement with the theory.



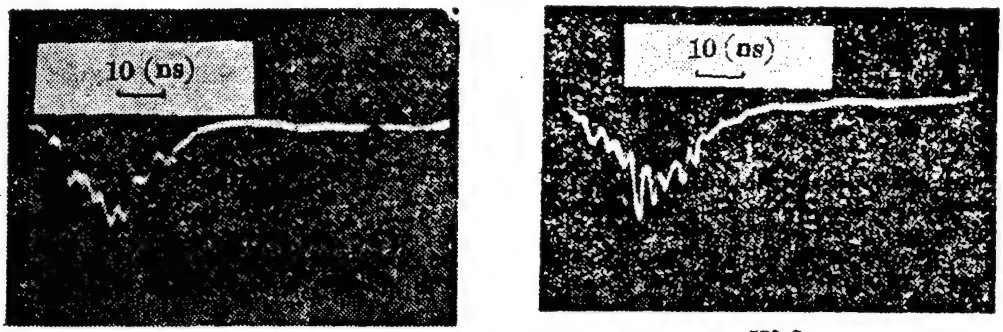
510.6 nm 578.2 nm

(a) Time evolution of amplified spontaneous emission from the discharge tube



510.6 nm 578.2 nm

(b) Time evolution of laser with a total reflection mirror and a glass plate as reflectors



510.6 nm 578.2 nm

(c) Time evolution of the laser with two glass plates as reflectors

Figure 3

Figure 4. Waveforms of 578.2 nm self-mode-locked laser output with two glass plates as reflectors and a prism inserted in the cavity

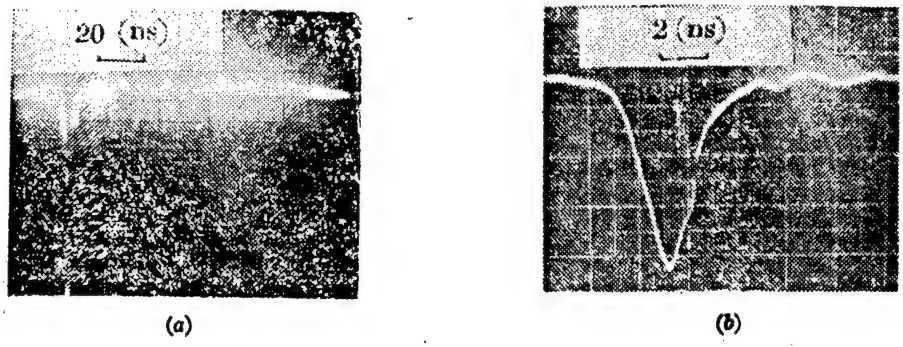


Figure 5. Single pulse laser output obtained under the same conditions as in Figure 4. The time scale in (b) is limited by the measuring equipment. (Time scales in (a) and (b) are 10 ns/div and 1 ns/div respectively)

IV. Conclusion

We reported the observation and analysis of a new type of rapid oscillations in high gain lasers caused by the spatial inhomogeneity of the population inversion. This type of oscillation is different from the relaxation oscillation[4] caused by the instability of the coupling equation solution in the interaction of the inverse population and the light field. The conditions for observing the new rapid oscillations require a large spatial modulation of the inverse population. The following conditions must be met:

(1) The Q of the cavity cannot be too great; otherwise the inverse population remains near the threshold and the modulation will be small.

(2) The Q of the cavity cannot be too small; otherwise the intensity will be too low and the population inversion will not be saturated enough for modulation. The light intensity in the cavity cannot be too high either; otherwise the inverse population will be high saturated and $I_+ \approx I_{0,+z}$, $I_- \approx I_{0,-(1-z)}$, $I_+ + I_- \approx$ constant, consequently the spatial modulation is lost.

(3) From Eqs. (1) and (2), the gain medium in the cavity must have a very high gain.

In addition, the cavity length L and the reflectivity r of the cavity mirror must satisfy a certain relationship so that a_+, a_-, b_+, and b_- determined by (7) have certain values. When any of them becomes infinity the system will deviate far from the zeroth order approximate solution and makes a transition to the self-mode-locked state.

The authors thank Zhang Guiyan [1728 2710 3601] and Jing Chunyang [2529 2504 7123] for providing the CuCl laser.

Appendix

We write the boundary conditions as

$$\Delta I_+(t,\ 0)=r_1\Delta I_-(t,\ 0), \tag{A-1}$$

$$\Delta I_-(t,\ l)=r_2\Delta I_+\left(t-2\frac{L-l}{c},\ l\right). \tag{A-2}$$

and let

$$e_+(y)=a_+\cos\frac{1}{2}kcy+b_+\sin\frac{1}{2}kcy,$$

$$e_-(x)=a_-\cos\frac{1}{2}kcx+b_-\sin\frac{1}{2}kcx. \tag{A-3}$$

We then substitute (A-3) into (A-1) and set the coefficients of cos ½kct and sin ½kct on the two sides of the equation equal. We obtain

$$a_+=R_1a_-;\ b_+=R_1(1+b_-)-1;\ R_1=r_1\frac{I_{0,-}(0)}{I_{0,+}(0)}, \tag{A-4}$$

Substituting (A-3) into (A-2) and using ½kℓ = π, we have

$$R_2\left[\sin\left(\frac{1}{2}kct\right)+a_-\cos\left(\frac{1}{2}kct\right)+b_-\sin\left(\frac{1}{2}kct\right)\right]=\sin\left(\frac{1}{2}kct-\phi\right)$$

$$+a_+\cos\left(\frac{1}{2}kct-\phi\right)+b_+\sin\left(\frac{1}{2}kct-\phi\right), \tag{A-5}$$

where

$$\phi=k(L-l),\quad R_2=\frac{I_{0,-}(l)m\left(t-2\frac{L-l}{c}\right)}{r_2I_{0,+}(l)m(t)}. \tag{A-6}$$

We expand the right-hand side of (A-5) and compare the coefficients of sin ½kct and cos ½kct on the two sides. With the help of (A-4), we obtain

$$(R_1\sin\phi)a_-+(R_1\cos\phi-R_2)b_-=R_2-R_1\cos\phi,$$

$$(R_1\cos\phi-R_2)a_-+(R_1\sin\phi)b_-=R_1\sin\phi. \tag{A-7}$$

The determinant of the equation is

$$\Delta = R_1^2 - 2R_1R_2\cos\phi = (R_1 - R_2)^2 + 4R_1R_2\sin^2\frac{\phi}{2}.$$

In order for Δ to be zero, we have to satisfy $R_1 = R_2$ and $\sin^2(\phi/2) = 0$ simultaneously. The latter is equivalent to $\cos\phi = 1$. The behavior of a_- and b_- may then be obtained from Eq. (7) in the test under the limits $R_1 - R_2 \to 0$ and $\sin(\phi/2) \to 0$.

For example, (7) gives

$$a_- = \frac{4R_1\cos\frac{\phi}{2}\left[(R_2 - R_1\cos\phi)/(R_1 - R_2)\right]}{\left[\frac{R_1 - R_2}{\sin\phi/2} + 4R_1R_2\sin\frac{\phi}{2}\Big/(R_1 - R_2)\right]}. \qquad \text{(A-8)}$$

and $a_- \to \infty$ if $(\sin\phi/2)/(R_1 - R_2) \to 0$, when $R_1 - R_2 \to 0$, $\sin\phi/2 \to 0$.

It should be pointed out that, for simplicity, the boundary conditions written above correspond to a special case. The more general boundary conditions satisfying Figure 2 are

$$\Delta I_+(t, 0) = r_1\Delta I_-\left(t - \frac{2d}{c}, 0\right),$$

$$\Delta I_-(t, l) = r_2\Delta I_-\left(t - \frac{2L - 2l - 4d}{c}, l\right).$$

The definitions of R_1 and R_2 then become

$$R_1 = r_1\frac{I_{0,-}(0)m\left(t - \frac{2d}{c}\right)}{I_{0,+}(0)m(t)}, \qquad R_2 = \frac{I_{0,-}(l)m\left(t - \frac{2L - 2l - 4d}{c}\right)}{r_2I_{0,+}(l)m(t)}.$$

Then, using the boundary conditions of the zeroth order approximation solution, we have $r_1\frac{I_{0,-}(0)}{I_{0,+}(0)} = 1$, $I_{0,-}(l)/[r_2I_{0,+}(l)] = 1$. As a result, we obtain

$$R_1 = \frac{m(t - 2d/c)}{m(t)}, \qquad R_2 = m[t - (2L - 2l - 4d)/c]/m(t).$$

where m depends on the population saturation caused by the light intensity.

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APPLIED SCIENCES

UV EXCIMER LASER USED IN TRIGGERING LOW-JITTER SPARK GAPS THROUGH FIBER

Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 6, No 7, Jul 86 pp 625-629

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[Text] Abstract: The transmission characteristics of the radiation from a UV XeCl excimer laser through fused quartz fibers have been investigated. The laser beam transmitted via optical fiber was used to trigger a spark gap. Experimental results show that the triggering jitter is less than 3 ns. With use of two fibers, the same laser was used to trigger two spark gaps synchronously.

I. Introduction

The pumping source or the preionization source of high power pulsed gas discharge lasers usually consist of a multistage Max generator or transmission lines. The voltage pulse must have a fast rise time and low jitter. This means that the pulsed voltage source must have a spark gap with very low jitter. In high voltage discharge the pulse is usually used to trigger the spark gap switch, the jitter time of the spark gap depends strongly on the risetime of the signal.[1] However, a fast risetime requires additional spark gap or other components and the system becomes complicated. Moreover, electrically triggered high voltage systems are also susceptible to the interference of other electrical signals and may have instabilities in their trigger state.

A strong laser beam may be used to trigger the spark gap.[2] Since it is free from the interference of high voltage discharge pulses and has a low jitter time, it has been used in the technology of high pressure plasma, accelerators, and lasers. In the early studies visible and infrared lasers were used. The laser is collimated and focused at the spark gap. The requirement of precise alignment has limited its usefulness. Ultraviolet lasers should have better ionization and trigger characteristics than visible or infrared lasers. Fiber optics transmission allows us to introduce the high power laser beam directly into the spark gap, and the optical system in the atmosphere and

the requirement for precise alignment are eliminated. By adjusting the length of the fiber optics, the trigger delay time is controlled. The same laser beam may go through several fibers for the synchronous triggering of several switches or the trigger of several channels in the same switch. The technique is therefore very useful in practical applications.

II. Transmission Characteristics of XeCl Excimer Laser Light in Quartz Fiber

The experimental setup for measuring the transmission characteristics of XeCl excimer laser light in quartz fiber is shown in Figure 1. For a XeCl laser pumped by an X-ray preionization pulsed discharge, the typical pulse width is about 70 ns (FWHM) and the output energy is about 0.1-1 J.

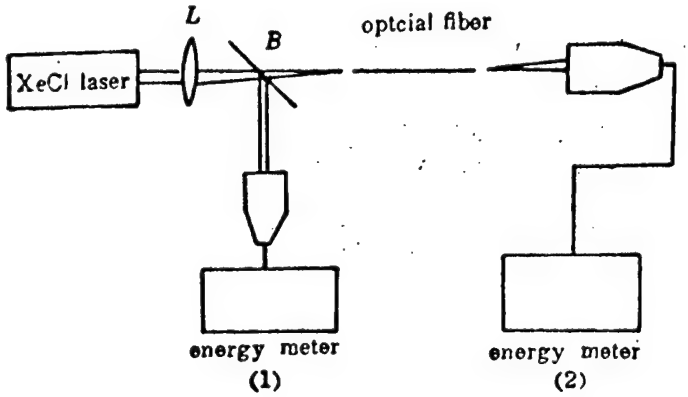


Figure 1. Schematic of the experimental setup for measuring the XeCl laser transmission characteristics through an optical fiber

The laser beam is coupled into the optical fiber by lens L. By changing the distance between the lens and the fiber surface and the laser output energy, the input power density of the fiber may be controlled. The beam splitter B, an uncoated quartz plate, is used to monitor the incident laser energy. The energy entering the fiber may be computed knowing the laser spot size at the end surface of the fiber and the cross-sectional area ratio of the incident end of the fiber. To improve accuracy, the spot size of the laser on the incident surface of the fiber is measured with a diaphragm and the average of 10 measurements is taken.

The optical fiber is a model GY-1 low-loss cylindrical quartz fiber. The core diameter is 650 μm, the diameter of the silicon gel coating is 1 mm, the input and output end faces are cut flat and treated at a high temperature. The output of the XeCl laser is multi-mode, the fiber is also multi-mode, and the coupling between the laser beam and the fiber does not depend on the laser beam quality.

Figure 2 shows the relationship between the input intensity and the output intensity. The length of the fiber is 9.6 m. The reason that we use a long fiber is to facilitate future applications where the laser is at a large

distance from the spark gap and one laser may be used to trigger two spark gaps separated by a large distance. The attenuation of the laser in the fiber is mainly due to Rayleigh scattering and Raman scattering. At a high pump level, Rayleigh scattering is generally believed to be the main cause for attenuation.

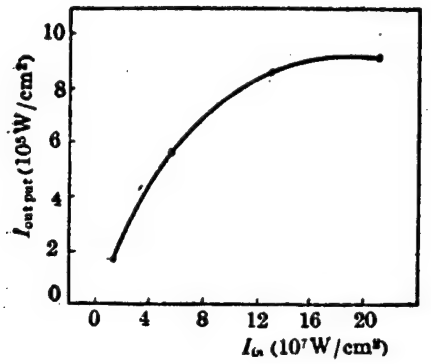


Figure 2. Input intensity of XeCl laser versus output intensity. The optical fiber is 9.6 m long.

According to the analysis of D.A. Pinnow et al., the light scattering coefficient may be written as[3,4]

$$\alpha = \frac{8}{9}\frac{\pi^8}{\lambda^4}(n^8p^2)(kT)\beta_T,$$

where λ is the wavelength, n is the refractive index of the fiber, p is the photoelastic coefficient, k is Boltzmann's constant, T is the absolute temperature, and β_T is the adiabatic compression coefficient. At a wavelength of 308 nm, we estimate $\alpha \sim 0.09$ dB/m. Using Figure 2, the fiber loss is 0.2 dB/m at an incident power density of 20-40 MW/cm^2. At an incident power of 200 W/cm^2, the loss is 0.25 dB/m. The experimental value differs from the prediction of the Rayleigh scattering theory because of the Raman scattering contribution and the presence of impurities in the fiber material.

To compute the power density, we must also measure the laser pulse width and the variation of the pulse width after passing through the fiber. Figure 3 shows the fiber output laser pulse width as a function of the fiber length. The output pulse width is 28 percent greater than the input pulse width. Figures 4(a) and 4(b) show respectively the typical waveform of a XeCl laser pulse and the pulse shape after passing through 9.6 m of fiber. In order to have the receiver operating in the linear region, attenuation plates of various transmissivity are used and the relative values are therefore not proportional.

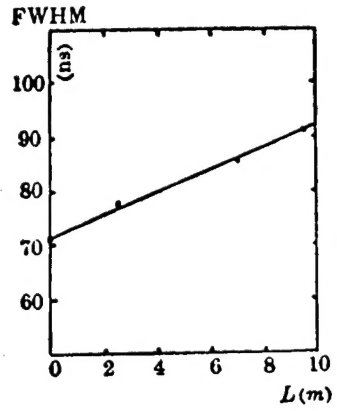
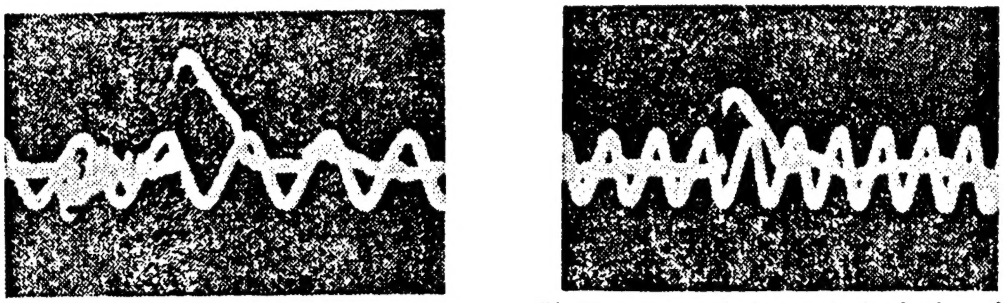


Figure 3. FWHM of the laser pulse output from the optical fiber as a function of the fiber length



(a) XeCl laser output pulse waveform

(b) Waveform of the laser output pulse from the 9.6m long optical fiber

(Time scale is 10MHz)

Figure 4

III. Triggering of the Spark Gap

The experimental setup is shown in Figure 5. The single gap characteristics are measured before the simultaneous triggering of two spark gaps. The gap consists of two ball-shaped electrodes, one has a small hole through the center to accommodate the optical fiber and the gap distance is about 5 mm. The value of the capacitance C is 8.1 nF, the load resistors are in the 10-35 Ω range. The spark signal waveform is detected by the R_3 and R_4 voltage divider and the OK-19 high voltage oscilloscope. The length of the optical fiber is 2.5-7 m. The incident laser waveform is monitored with a receiving system consisting of an ultraviolet photoelectric diode and a fast oscilloscope. By simultaneously measuring the waveform on the load resistor R_1, the delay characteristics and jitter can be obtained. Here we define the delay time as the time interval between the two corresponding starting points on the voltage across the load resistor and on the laser waveform incident on the optical fiber.

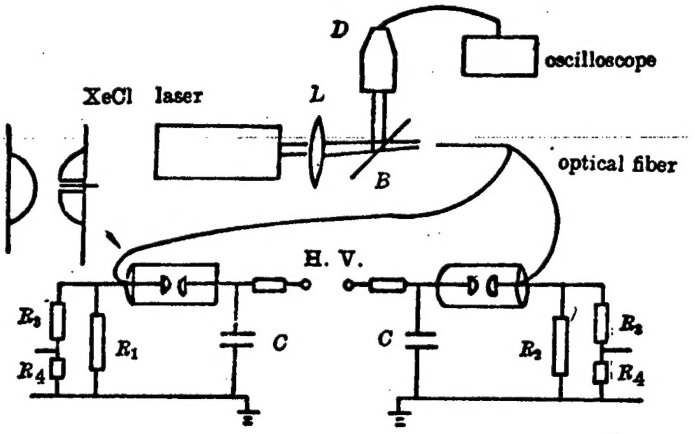


Figure 5. Schematic of the experimental setup for triggering the spark-gap switch by a XeCl laser through optical fiber

The delay time T_D changes with the incident laser power density. Figure 6 shows that T_D is approximately 700 ns when the incident laser power density is low (50 MW/cm^2). As the incident power density reaches 100 MW/cm^2, T_D decreases to about 100 ns. At this time the charging voltage of the gap is about 70 percent of the breakdown voltage. When the gap voltage reaches 90 percent of the breakdown voltage, the delay time T_D drops to about 20 ns. We have also compared spark gaps triggered by a high voltage pulse using a trigger pulse with a 400 kV/μs leading edge. When the gap voltage reaches 70 percent of the breakdown voltage, the delay time is about 460 ns. At 90 percent of the breakdown voltage, T_D is about 100 ns. Therefore, under our testing conditions, the delay time is reduced by a factor of 4-5 when a laser is used for the triggering.

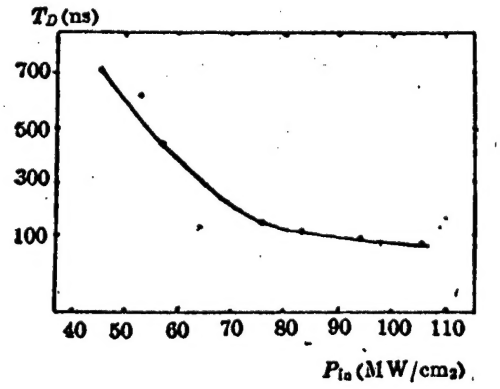


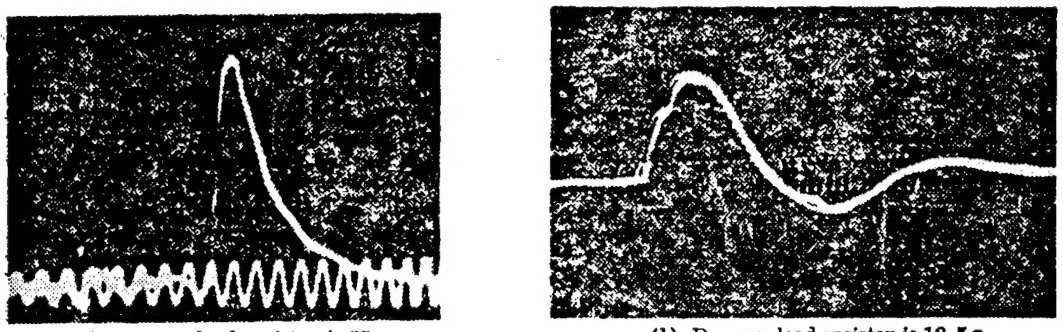
Figure 6. Input intensity of XeCl laser versus delay time T_D

The average delay time $\overline{T}_d$ of the pulses is obtained by making multiple exposures on the same film of the laser triggered spark voltage waveforms on resistor R_1 using the threshold of rise of the laser pulse waveform as the zero of time. The actual delay time of the ith pulse is T_{di}. The jitter

of the ith pulse is defined as $\Delta_i = T_{di} - \overline{T}_d$. The root mean square jitter time $\overline{\Delta}_i$ is given by

$$\overline{\Delta}_i = \left[\frac{1}{N}\sum_{i=1}^{N}(\Delta_i)^2\right]^{\frac{1}{2}}.$$

Figure 7(a) shows 10 overlapping pulse waveforms when the load resistance is 35 Ω. As can be seen, the 10 pulses overlap exactly. The time marker in the figure is 10 MHz. To measure the jitter time we expanded the time marker to 100 MHz and reduced the load resistance to 12.5 Ω. The entire loop was then in a weak damping state. Figure 7(b) shows the 10 pulses recorded on the same film. The rms jitter time is about 3 ns. Since the start of the laser pulse on the OK-19 oscilloscope has about 3 ns of fluctuation, the laser triggered spark gap jitter time is therefore less than 3 ns. In the above experiment the laser power density incident on the optical fiber is 158 MW/cm^2 and the spark gap is charged to a voltage of 90 percent of the self-breakdown voltage. Like the delay characteristics comparison, we again compare the above results with the jitter characteristics of an electrically triggered spark gap. When the gap is charged to a voltage of 80 percent and 90 percent of the breakdown voltage, the jitter times are respectively 50 ns and 15 ns. Under our experimental conditions, the use of the laser triggered spark gap has reduced the jitter time by one order of magnitude or more.



(a) Dummy load resistor is 35 Ω (b) Dummy load resistor is 12.5 Ω

Figure 7. Voltage waveform on dummy load

Using the layout of Figure 5, a laser beam can trigger two spark gaps simultaneously. The two sets of capacitors each discharge through a spark gap and a load resistor. The end faces of the two optical fibers of the same type are in the same plane. The laser beams are adjusted so that the incident laser power densities are both 160 MW/cm^2. The discharge signals measured by the voltage dividers are fed into the two synchronized sweeps of the OK-19 oscilloscope. The jitter between the two voltage waveforms is observed on the oscilloscope. Experiments show that the rms jitter times of both signals are less than 3 ns, indicating a good synchronization between the two spark gaps.

IV. Conclusion

Using an ultraviolet XeCl excimer laser beam, we measured the transmission characteristics of Chinese made quartz fibers. The measured transmission loss is 0.2-0.25 dB/m at a wavelength of 308 nm using a 70 ns wide laser pulse and an incident power density of 20-200 MW/cm^2. This transmission loss is close to the 0.09 dB/m estimated from Rayleigh scattering.

The ultraviolet laser beam passes through the optical fiber and then triggers a spark gap. When the spark gap is charged to 90 percent of the breakdown voltage, the jitter time is less than 3 ns. The same laser beam may pass through two optical fibers and trigger two spark gaps with a high degree of synchronization. This technique may be applied to high power pulsed discharge gas lasers, free electron lasers, high energy accelerators, and short pulse laser oscillation and amplification systems.

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